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ABSTRACT

The first part of this report reviews an extensive series of studies concerned with the reciprocal teaching of comprehension fostering and monitoring strategies--an instructional method in which an adult teacher and a group of students take turns leading a dialogue aimed at revealing the meaning of the text. The studies reviewed indicate that after extensive exposure to these reading dialogues, poor readers improve, not only in their contribution to the dialogues, but also in their independent comprehension performance in the laboratory, in the classroom, and on standardized tests. The report then describes comparisons of reciprocal teaching with other viable teaching methods, including modelling, direct instruction, and practice. In addition, a description is provided of attempts to hand the procedures over to a variety of teachers, experienced, inexperienced, and peer tutors, as well as mapping modifications needed to ensure that the method survives under the pressures of actual classroom conditions. Finally, the report describes how to use reciprocal teaching dialogues with young and slower learners to improve both reading and listening comprehension. (Author/HOD)

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CENTER FOR THE STUDY OF READING

Technical Report No. 334

RECIPROCAL TEACHING OF COMPREHENSION STRATEGIES: A NATURAL HISTORY OF ONE PROGRAM FOR ENHANCING LEARNING

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Abstract

In this chapter, we review an extensive series of studies concerned with the reciprocal teaching of comprehension-fostering and monitoring strategies. Reciprocal teaching refers to an instructional method in which an adult teacher and a group of students take turns leading a dialogue aimed at revealing the meaning of the text. During this dialogue, the assigned teacher (adult or student) summarizes the content, asks a question concerning the gist, clarifies any misunderstandings, and attempts to predict future content. After extensive exposure to these reading dialogues, poor readers improve, not only in their contribution to the dialogues, but also in their independent comprehension performance in the laboratory, in the classroom, and on standardized tests.

In this chapter, we describe comparisons of reciprocal teaching with other viable teaching methods, including modelling, direct instruction, and practice. In addition, we describe attempts to hand the procedures over to a variety of teachers, experienced, inexperienced, and peer tutors, as well as mapping modifications needed to ensure that the method survives under the pressures of actual classroom conditions. Finally, we describe how to use reciprocal teaching dialogues with young and slower learners to improve both reading and listening comprehension. The practical and theoretical significance of these studies is

emphasized throughout, together with the relation between reading dialogues and the instruction of critical thinking skills.

Reciprocal Teaching of Comprehension Strategies: A Natural History of One Program for Enhancing Learning

A long standing goal of our research program is to help students perform well where they previously could not. The aim has been to design instruction that really works in the practical sense of helping students not only to improve their performance on a particular task now, but also to take charge of their own learning in the future (Brown, 1978; Brown, Bransford, Ferrara, & Campione, 1983; Brown & Campione, 1978, 1981; Scardamalia & Bereiter, in press). Preferably, the instructional designs would rest upon clear theoretical principles so that we would know why they worked. The research process would then be generative, generative in that students would come to learn on their own, and generative in the sense that the theoretical principles underlying the research could guide instruction in many contexts and for many learners.

In this report, we will trace the history of one program of research aimed at improving the reading comprehension scores of academically marginal students (Brown & Palincsar, 1982; Palincsar & Brown, 1984). Our inquiry began as a prototypical research project conducted in a laboratory under ideal conditions: (a) The instructor was an expert teacher/researcher. (b) The students were handpicked; they were carefully diagnosed as particularly in need of the specific instruction they were to receive. (c) The ratio of students to teachers was extremely

favorable, either one-to-one or student dyads. And (d) the material was carefully prepared for the instructional purposes of the study. After the initial laboratory success, a primary aim of the research program has been to transport the procedure to situations more representative of the pressures of normal classrooms. This research into practice process is itself an object of on-going research.

To describe the history of this project as following the traditional research into practice route, however, suggests too much of a one-way process, i.e., research provides answers that are merely translated into educational practice. But we would argue that practice informs research just as much as research translates into practice. For example, we have learned a great deal from observations of expert (Collins & Stevens, 1982; Palincsar & Brown, 1984, Study 2) and not-so-expert teachers (Allington, 1980; Au, 1980; Collins, 1980). By considering how good teachers actually teach and how learners actually learn in real academic contexts, not only are we able to design better instruction, but we are also able to improve our theories of learning and teaching. In addition, instructional research of the kind reported in this chapter provides a valuable tool for testing theories concerning the cognitive mechanisms involved in reading and studying. Given this recursive research model, any separation between theory, research, and practice is artificial.

We believe that the ideal program would involve all aspects, with practice informing theory and vice versa.

The greater part of this report is devoted to our work with junior high school poor readers. Here, we describe one successful strategy training procedure, reciprocal teaching, and comparisons between it and other viable teaching methods. Having established that the procedure works under laboratory conditions, we then attempted to hand over control to a variety of teachers: volunteers, non-volunteers, and peer tutors. We then describe extensions of the procedure to listening comprehension instruction and to content areas other than reading. Finally, we discuss the implications of this research for learning from texts in general, and for students from special populations in particular. The theoretical significance as well as the practical importance is emphasized throughout.

Reciprocal Teaching of Comprehension-fostering and Monitoring Activities

Much of what we call reading in the later grades is actually critical thinking and studying. Students are not only required to decode, i.e., translate the written words into spoken words, they are also required to understand the meaning, critically evaluate the message, remember the content, and even apply the new found knowledge flexibly and creatively. In a scientific and technological society based on an increasingly complex and rapidly changing information base, a productive member of society

must be able to acquire new facts, critically evaluate them and adapt to their implications. Reliance on remembered facts and fallacies from outmoded past schooling will not suffice. Schools, therefore, need to develop intelligent novices (Bransford, Vye, Adams, & Perfetto, in press; Brown, Bransford, Ferrara & Campione, 1983). Intelligent novices are those who, although they may not possess the background knowledge needed in a new field, know how to go about gaining that knowledge. Intelligent novices have learned how to learn from texts rather than merely to memorize facts.

There is considerable evidence that a sizable minority of school leavers, when they encounter college, the armed forces or the workplace, lack the skills of the intelligent novice. Questioned about their preferred study strategies, high school students vary in their sophistication. For example, one student claimed that when called upon to study, ". . .I stare real hard at the page, blink my eyes and then open them--and cross my fingers that it will be right here" (pointing at his head). A somewhat better informed peer replied, "It's easy, if she (the teacher) says study, I read it twice. If she says read, it's just once through." A third student answered, "I just read the first line in each paragraph--it's usually all there." These are not expert readers.

The main purpose of our research program has been to teach such students to improve their strategies for studying texts. In

order to guide that research, however, we needed: (a) a theory of the task; (b) a theory of the development of competence on that task, and (c) a theory of instruction.

A Theory of the Task

What does reading comprehension actually involve? There are many situations where students must understand what they read and many reading comprehension tasks. We selected for study an ubiquitous school test of comprehension, which is actually a test of remembering as well as understanding. The students read a text and are then asked to answer questions about its content from memory. Failure to perform well on such tasks often leads to the labelling of many students as poor comprehenders. In order to perform well on them, students must expend effort and ingenuity.

Anything other than pleasure reading demands a great deal of effort. Effort alone will not do it, however; one unsuccessful college student reported reading the text "over and over again, eight or ten times until I fell asleep, and I still didn't pass the test." Effort must be coupled with strategic ingenuity. Expert readers proceed quite differently when they are reading to meet strict criteria of understanding or retention than when they are merely reading for pleasure or to obtain a quick impression of the gist. When reading for pleasure, they progress rapidly and, seemingly, effortlessly. When they are studying, however, they proceed slowly and laboriously, calling into play a whole

variety of learning and self-monitoring activities. Learning from texts demands a split mental focus (Brown, 1980; Locke, 1975). Learners must simultaneously concentrate on the material they are reading and on themselves as learners, checking to see if the mental activities engaged in are resulting in learning. Effective comprehension strategies are those that serve this dual function; they both enhance comprehension and afford an opportunity for the learner to monitor the level of comprehension. It is these comprehension-fostering and monitoring strategies that we wanted to instruct.

Of the many candidate strategies, we selected four that could be translated into concrete activities readily understood by novice learners, summarizing (self-review) the main content, formulating potential test questions, clarifying occasions of ambiguity, and predicting future content. These four activities can all serve the dual function, if properly used. Self-directed summarization is an excellent case in point. If readers cannot generate an adequate synopsis, this is a clear sign that comprehension is not proceeding smoothly and that remedial action is called for. Attempts to state the gist of what one is reading, and asking questions of clarification, interpretation, and prediction are activities that both improve comprehension and permit students to monitor their own understanding. These strategies formed the bases of our instructional package.

Experts and Novices: The Development of Competence

Theories of comprehension suggest that active learning from texts must involve a flexible repertoire of comprehension-fostering and monitoring activities. If so, one would expect to find empirical support for this position by studying experts and novices. Experts should use such activities when they study; novices should experience particular problems in recruiting active learning strategies. The data support these claims.

Experts report that they spend a great deal of time engaging in activities that look very like summarizing, questioning, clarifying, and predicting. This is true of both retrospective reporting of how they typically go about studying and of on-line protocols collected as students are learning from texts (Brown & Lawton, 1985). Experts refer constantly to the need to summarize the gist, to resolve ambiguities, to interpret content, to predict outcomes or future content, and to gauge likely tests of the knowledge they are acquiring. Novices do not. Novices neither report a great deal of reliance on such knowledge extending and refining activities, nor do these activities feature markedly in their on-line protocols. Whereas the experts' preferred studying mode involves questioning, clarifying, and interpreting, the novices prefer a once-over read, or a desperate, non-focused re-read (Brown & Lawton, 1985).

Experimental studies confirm these self-reports. Novices, particularly slow-learning children, rarely engage in active

learning. For example, although even very young children understand the essential features of a summary (Brown, Day, & Jones, 1983; Johnson, 1983), students cannot adequately summarize a typical fifth grade academic text until well into the high school years. Academically delayed students, i.e., remedial readers, have not mastered this ability by the time they reach college (Brown & Day, 1983). Documentation of students' difficulties generating questions on what they are reading is extensive, and again the problem is particularly acute for the slower student (Andre & Anderson, 1978-79). Similarly, there is considerable evidence that young and poor readers have difficulty evaluating texts for clarity, internal consistency, or compatibility with known facts (Garner, 1981; Markman, 1981).

The general picture to emerge is that, when tested for retention and comprehension after time to read material over once, younger and weaker students do not perform very differently from older students. However, when extra time is given for studying, large developmental and comparative differences emerge because the novices are not using the required strategies spontaneously (Brown & Smiley, 1978; Brown, Smiley, & Lawton, 1978). The need for explicit instructions in comprehension-enhancing activities is particularly acute for the slow-learning student (Baker & Brown, 1983, 1984; Brown, Armbruster, & Baker, in press; Brown & Palincsar, 1982).

In the studies reported in this chapter, we have concentrated primarily on a subject population particularly in need of extensive training in reading comprehension. These are junior high school students who can most accurately be described as performing academically at the lower end of the normal distribution. They are not officially labelled as learning disabled by the schools, although it is not clear why not. They are not mentally retarded, for their IQ, vocabulary and achievement scores are within the normal range, albeit at the lower end. Their IQ scores tend to cluster in the mid 80's, and their vocabulary, comprehension, and mathematics scores are typically two years below normal. Although by junior high school they have mastered decoding to the extent that they can read grade appropriate texts with an acceptable level of fluency (Lovitt & Hansen, 1976a), their comprehension problems are a severe block to reading and studying as they progress to content area subject matter. Without explicit instruction in reading for meaning and retention, the academic prognosis for these students in high school is quite poor. We selected this population because we believe that with such students we can really effect meaningful improvements. Extensions of our basic procedures to younger students in the interests of diagnosis and prevention of reading delay will be discussed in the latter part of the paper.

A Theory of Instruction

Having established that theoretically specified strategies do contribute to effective reading and that novices do not employ them readily, we now turn to the third step, the mode of instruction. How should we proceed to teach the novices to acquire new skills, and, more importantly, to take charge of their own learning in the future?

The procedure we developed is a form of expert scaffolding (Bruner, 1978; Cazden, 1979). Expert scaffolding refers to situations where an expert (a teacher, a peer, a parent, a mastercraftsman) provides a supporting context in which students may gradually acquire skills. The expert, the teacher, initially takes on the major responsibility for the group's activity. Novices are encouraged to watch and then to participate before they are able to perform unaided, the social context supporting the individual's efforts. The teacher models and explains, relinquishing part of the task to the novices only at the level each one is capable of negotiating at any one point in time. Increasingly, as a novice becomes more competent, the teacher increases her demands, requiring participation at a slightly more challenging level.

Reciprocal teaching is a form of expert scaffolding in the classroom. The basic procedure is simple. A teacher and a group of students take turns leading a dialogue concerning a section of text they are jointly attempting to read and understand. The

dialogue includes spontaneous discussion and argument and the four main comprehension-fostering activities: summarizing, questioning, clarifying, and predicting. The adult teacher assigns a segment of the passage to be read and either indicates that it is her turn to be the teacher or assigns a student to teach. After all have read the segment silently, the assigned teacher for that unit summarizes the content, asks a question that a teacher or test might reasonably ask, discusses and clarifies any difficulties, and finally makes a prediction about future content. All of these activities are embedded in as natural a dialogue as possible, with the teacher and students giving feedback to each other.

We based our instructional design on certain central principles: (a) the teacher should model the desired comprehension activities, thereby, making underlying processes overt, explicit, and concrete; (b) the teacher should model the activities in appropriate contexts, not as isolated decontextualized skills; (c) the students should be fully informed of the need for strategic intervention and the range of utility of a particular strategy; (d) students should realize that the use of strategies works for them; (e) the responsibility for the comprehension activities should be transferred to the students as soon as they can take charge of their own learning; (f) this transfer of responsibility should be gradual, presenting students with a comfortable challenge; and (g) feedback should be

tailored to the students' existing levels, encouraging them to progress one more step toward competence.

Following these basic principles, reciprocal teaching involved extensive modeling of the type of comprehension-fostering and monitoring activities that are usually difficult to detect in the expert reader, as they are executed covertly. The procedure provided a relatively natural forum for the teacher to engage in these activities overtly, and hence to provide a model of what it is that expert readers do when they try to understand and remember texts. The modeling also served to demonstrate to the students concrete ways of monitoring their own learning, methods that they could readily understand.

The strategies were always modeled in appropriate contexts, not as separate skill exercises. Thus, the four strategies of summarizing, questioning, clarifying, and predicting were embedded in the context of the dialogue between student and teacher that took place during the actual task of reading with a clear goal of deriving meaning from the text. Each "separate" activity was used in response to a concrete problem of text comprehension. Summarizing was modeled as an activity of self-review, a means of determining that the content had been understood. If an adequate synopsis could not be reached, this fact was not regarded as a failure to perform a particular decontextualized skill, but as an important source of information that comprehension was not proceeding as it should, and that

remedial action (such as re-reading or clarifying) was needed. Questioning was not practiced as an isolated activity, but as a continuing goal of the whole enterprise--to what reasonable test could one's learning be put? Clarifying occurred only if there were confusions, whether in the text (unclear referent, etc.) or in the student's interpretation of the text. Similarly, prediction was attempted if the students or teachers recognized any cues that served to herald forthcoming material. In short, all of the activities were undertaken when appropriate in the context of actually reading with the goal of understanding and remembering.

The teacher attempted to transfer these activities to the students' control in such a way that they would understand why the strategies were needed, why they were effective, and when and where they were to be used. The students were fully informed concerning the nature of the strategies, their efficiency and their range of utility (Brown, Campione & Day, 1981). In other words, attention was paid to the metacognitive aspects of learning from texts (Baker & Brown, 1984; Brown, 1980; Brown, Armbruster & Baker, in press).

An important aspect of the reciprocal teaching procedure is that the students must respond when it is their turn to be the teacher, or when they answer the questions of other teachers. The students respond even if they are not yet expert. Because the students do respond, the teacher has an opportunity to gauge

their competence; competence that in many procedures is masked by weaker students' tendency not to respond until they are sure of themselves.

As a form of expert scaffolding, reciprocal teaching involves continuous trial and error on the part of the student, coupled with continuous adjustment on the part of the teacher to the student's current competence. Through interactions with the supportive teacher and their more knowledgeable peers, the students are led to perform at increasingly more mature levels; sometimes this progress is fast, sometimes slow, but irrespective of the rate, the teacher provides an opportunity for the students to respond at a slightly challenging level. The teacher does not merely instruct the students and then leave them to work unaided; she enters into an interaction where the students and the teacher are mutually responsible for getting the task done. As the students adopt more of the essential skills initially undertaken by the adult, the adult acts less as a model and more like a sympathetic coach. In order to perform this essential role, however, the teacher must somehow be sensitive to each student's changing cognitive status. She must engage in on-line diagnosis that involves continuous evaluation and revision in her theory of the student's competence, a theory that must be responsive to the level of participation of which that student is currently capable.

In summary, the reciprocal teaching procedures of this program involve expert modeling of four comprehension-fostering and monitoring activities: summarization, questioning, clarifying, and predicting. The teacher and students take turns leading a dialogue on silently read sections of text; in these dialogues, the students practice the four strategies. The teacher's role is to model the activities and to engage the students at a level judged to be within their grasp at any moment in time. As the students master one level of involvement, the teacher increases her demands so that the students are gradually called upon to adopt the expert role more fully and independently. The teacher then fades into the background as the students take charge of their own learning from texts.

A Successful Laboratory Study

In this section we will review the highlights of the original laboratory studies of reciprocal teaching and subsequent attempts to compare the success of the intervention with the outcomes of other theoretically viable training methods. Actually, the original laboratory demonstration consisted of two studies (Brown & Palincsar, 1982; Palincsar & Brown, 1984, Study 1); in both, Palincsar served as the adult teacher, but in the first, she interacted with students individually and in the second, she worked with pairs of children. As the second study was by far the more extensive, we will use it to demonstrate the procedure[1].

Reciprocal Teaching

Seventh grade students took part in the study. They were average decoders but their reading comprehension scores were at least two years delayed. The students were given a variety of pre-tests of their ability to summarize, question, and clarify before entering a baseline phase in which they read novel passages each day and answered ten comprehension questions on these texts from memory. During the twenty days of training, these daily assessments were preceded by the reciprocal teaching intervention, which centered around other novel texts. For each day, therefore, we were able to collect the students' individual contributions to the dialogues and their independent scores on the subsequent, privately read, novel passages.

Dialogue changes. Consider first the students' contributions to the group dialogues. Initially the teacher modeled appropriate activities but the students had great difficulty assuming the role of dialogue leader when their turn came. The experimenter was sometimes forced to resort to constructing paraphrases and questions for the students to mimic. In this initial phase, the experimenter was modeling effective comprehension-monitoring strategies but the students were relatively passive observers.

In the intermediate phase, the students became much more capable of playing their role as dialogue leader, and by the end of the training sessions they were providing paraphrases and

questions of some sophistication. Unclear questions and summaries dropped out and were replaced over time with questions and summaries focusing on the main idea of each text segment. This reliable trend is shown in Figures 1 and 2. Examples of student responses are shown in Tables 1 and 2.

Insert Figures 1 and 2 and Tables 1 and 2 about here.

With repeated interaction with an adult model performing appropriate questioning and paraphrasing activities, the students became able to perform these functions on their own. Over time, the students' questions and summaries became more like the teacher's, being classified as inventions, i.e., questions and summaries of gist in one's own words, rather than selections, repetitions of phrases actually occurring in the text (Brown & Day, 1983). For example, an early occurring form of question would be to take verbatim from the text, "Plans are being made to use nuclear power," and convert it to a question by appending the inflection, "for what?" Later forms of questioning and summarizing were more likely to be paraphrases of the gist in the students' own words and often would integrate text information that had occurred across several sentences.

Close inspection of the dialogues revealed the teacher's sensitivity to students' different rates of progress. The teacher repeatedly provided modeling, feedback, and practice to students at a level that appeared to match the student's current

need. As students became better able to perform some aspects of the task, the teacher increased her demands accordingly, until the students' behavior became increasingly like that of the adult model, who in turn decreased her level of participation and acted as a supportive audience.

One example of such an interaction is shown in Table 3. This dialogue occurred with a seventh grade minority student,

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Insert Table 3 about here.

Charles (IQ = 70, reading comprehension grade equivalent = third grade). At the beginning of the training session, Charles was unable to formulate a question. The teacher, estimating that he was having more than usual difficulty with the task, opens her interaction by stating the main idea (Statement 2). She continues to lead him, asking for a "why" question (4) but, receiving no response, she resorts to forming the question for him to mimic (6). Even imitating a fully formed question is difficult for Charles (7, 9). Again, on Day 4, the teacher formulates the question (20), but this time she waits until Charles comes very close to an adequate question by himself. As Charles improves, the teacher demands more from him. On Day 4, the teacher does not open by providing the main idea, she probes for it (14) and probes for a question (16, 18), which she corrects (20). Note, however, that although the teacher actually

produces the questions on both Day 1 and Day 4, on Day 4 she waits until Charles has contributed most of the elements himself.

As Charles' ability to participate increases even further, the teacher again increases the level of participation that she demands from him. On Day 7, she requests a modification to his question form (23), but he formulated the question (24). By Day 11, she receives two excellent questions, but now demands only one (27), i.e., she requires him to stick to the exact rules of the game. Finally, by Day 15, Charles can perform his part unaided.

Charles was a particularly weak student at the start, unable to formulate questions at all. In contrast, Sara began the intervention with a clear notion of the kinds of questions that occur in school--"fill in the blanks." Excerpts from her protocol are shown in Table 4. On Day 2, the teacher, who has

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Insert Table 4 about here.

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tolerated "fill in the blanks" questions until this point, attempts to take the student beyond this level (2) and asks for a main idea rather than a detail question. On Day 3, Sara comes up with a main idea question as requested (3), so again the teacher increases her demands by suggesting that, instead of selecting a line from the text, the student summarize in her own words, i.e., she calls for an invention (Brown & Day, 1983). For the remainder of the sessions, Sara's questions are classified

primarily as inventions. The teacher has been modeling inventions, and the student has followed suit.

Daily comprehension scores. Consider next the daily independent comprehension scores. Average seventh graders scored 75% correct on these particular texts; but the poor comprehenders who were the subjects of the reciprocal teaching intervention began scoring below 40% correct. Their individual progress is plotted in Figure 3. Twelve days of reciprocal teaching

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Insert Figure 3 about here.

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experience is sufficient to bring five of the students up to the level set by normal seventh grade readers. The remaining student (Student 2) progressed from a baseline of 10% and reached a steady level of 50% correct, again in twelve days. (Student 2 had a full scale IQ of 67 and was four years delayed in reading comprehension scores.)

All of the reciprocal teaching students maintained their improved level of performance on the maintenance sessions and on the follow up sessions that took place eight weeks after the intervention had ceased. In the original pilot study (Brown & Palincsar, 1982), we examined long term maintenance after a six month interval. Although performance after six months fell from 80% to 60% correct, 60% was still a reliable improvement on the starting level of 20%, and only one reintroduction of the

reciprocal teaching procedure was needed before performance again reached the 80% level, a considerable saving effect.

Relation of social dialogue and independent study activities. If we consider the six students in the reciprocal teaching group as individual cases, then a close relation between improvement in the dialogues and improvement in the assessment passages and transfer tests can be seen. The students differed in terms of starting competence, and responded to the instruction at different rates, but in all cases improvement was shown first in the dialogues, was then reflected in the students' individual scores, and subsequently in their classroom behavior, a pattern of results that suggests a gradual internalization (Vygotsky, 1978) of behavior, originally perfected in a social setting. The reciprocal teaching dialogue provided the contextual support for the first emergence of the skills, with students and teachers providing examples, support, and feedback for each other. After a new skill was practiced in the group setting, the student then became able to apply it independently on the daily assessments and finally in the classroom generalization tests. (For detailed case studies, see Palincsar & Brown, 1984).

Transfer tests. Three types of transfer tests were used to evaluate the more general effects of training: (a) generalization probes in the classroom; (b) laboratory transfer tests; and (c) improvement in standardized scores.

First, consider the generalization probes. Following a traditional practice in the cognitive behavior modification literature (Meichenbaum, 1977), we administered identical tests in the classroom setting. The students read passages in their science and social studies classes and answered ten comprehension questions on them from memory. No mention was made that these tasks formed part of the study; and to maintain the cover, all seventh graders (N = 130) took the tests as part of their regular classroom activity. The classroom probes were taken five times during the course of the study, the first probe occurring during baseline, the second and third occurring during the first and second half of the interventions, the fourth occurring during maintenance, and the fifth probe occurring during followup, eight weeks after the termination of training. A comparison between the generalization test performance of the reciprocal teaching students and a group of matched untreated control students is shown in Figure 4, where it can be seen that the reciprocal teaching group improved steadily and the control group did not.

Insert Figure 4 about here.

Perhaps of more interest is the reciprocal teaching students' improvement in percentile rankings compared with all of the seventh graders in the school (students drawn from the full range of ability). Whereas the control group showed only random fluctuation resulting in a change from the 13th to 11th

percentile on social studies and the 20th to 19th on science, the reciprocal teaching students who reached criterion improved from the 25th to 78th percentile on social studies and from the 5th to 69th percentile on the science probe. (Student 2 did not improve.)

Next, consider the laboratory transfer tests which were given on both the pre- and posttest sessions. Reciprocal teaching students showed reliable improvement in their ability to apply macrorules to the task of writing summaries of texts (Brown & Day, 1983), in their ability to write appropriate comprehension questions to accompany a text, and in their ability to detect anomalous sentences in texts (Harris, Kruithof, Terwogt, & Visser, 1981). The control students did not show any posttest improvement. (For full details of the transfer tests, see Palincsar & Brown, 1984.)

To give the flavor of the complex transfer results, in Figure 5 we illustrate the type of improvement found on

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Insert Figure 5 about here.

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summarizing and question predicting. On the transfer tests the reciprocal teaching students improved reliably and control subjects did not; the extent of the improvement was to eliminate the difference between the reciprocal teaching students and untrained average readers on these tests.

Our final measure of transfer was to consider the students' improvement on a standardized test of reading comprehension (the Gates-MacGinitie). Retesting after the four month intervention period, one would expect a gain of four months if the intervention had made no difference and the students were progressing normally. In fact, the control group gained one month on comprehension and three months on vocabulary, a reflection of the fact that slower students such as these experienced a cumulative deficit, with an expected gain of only six to eight months rather than twelve each year. Ignoring Student 2, who did not improve, the reciprocal teaching group averaged a twenty month gain on their comprehension scores, compared with two months on their vocabulary scores. For these students the intervention was successful; in the case of two students, it increased their standing to slightly ahead of their grade level.

The outcome of the original laboratory tests of the reciprocal teaching procedure was successful according to many criteria. Indeed there were at least seven positive outcomes of the studies: (a) Students' ability to paraphrase, question, clarify, and predict clearly improved. (b) The students progressed from passive observers to active teachers, able to lead the dialogues independently. (c) The quantitative improvement on the comprehension tests was large and reliable; all but one student improved to the level set by good

comprehenders. (d) The effect was durable; there was no drop in the level of performance for up to an eight week period, and little after six months. (e) The effect generalized to the classroom setting, with students reaching or surpassing the average level for their age mates. (f) Training resulted in reliable transfer to laboratory tasks that differed in surface features from the training and assessment tasks: summarizing, predicting questions, and detecting incongruities all improved. (g) Sizeable improvements in standardized comprehension scores were recorded for the majority of subjects. Given the difficulty reported in obtaining generalization of trained cognitive skills across settings and tasks (Brown & Campione, 1978, 1981, 1984; Meichenbaum, 1977), these are impressive findings.

Comparative Studies

Reciprocal teaching of comprehension strategies proved to be a powerful instructional intervention for seventh grade poor readers. For practical purposes this is, perhaps, all one needs to know; teachers can teach and students can learn comprehension strategies through the reciprocal teaching interaction. We do not know, however, how reciprocal teaching compares with other viable methods for training comprehension. Neither do we know whether the entire set of strategies is necessary to effect improvement. Given the somewhat limited outcome of cognitive skills training studies in terms of significant, durable, and generalizeable improvements in independent learning, we advocate

the procedure of first engineering a meaningful improvement and then conducting the necessary follow-up studies to pinpoint the essential features of the intervention. Having achieved what we judged to be the first step, worthwhile improvement, we began a series of comparative studies designed to gauge the efficiency of essential features of reciprocal teaching.

Instructional practices. First, let us consider studies designed to pit reciprocal teaching against other forms of instruction. The study that included the six students just discussed also included eighteen other students, six assigned to each of three control groups. The entire group of twenty-four students was randomly selected from a pool of poor readers and randomly assigned to groups. They were matched on a variety of descriptive statistics including IQ, decoding, vocabulary, and comprehension scores, in addition to baseline and pretest competency (for details, see Palincsar & Brown, 1984).

The first group of six were the reciprocal teaching (RT) students already discussed. A second group of six formed an untreated control group (C) who merely took all of the baseline and pre- and posttest measures. Another group of six students received, in addition to the pre and post measures, all of the daily independent tests (T) but no intervention. The final group of six were assigned to an alternate treatment, locating information (LI), that preceded the daily assessments. The locating information intervention was modeled on a procedure

commonly used by remedial reading teachers to help students cope with answering questions on texts they have just read (Lovitt & Hansen, 1976b; Raphael, 1980). It involves demonstration and practice in test taking. After reading an assigned passage independently, the students attempted to answer the comprehension questions. The teacher praised correct responses; following incorrect responses, she guided the student back into the passage to the appropriate paragraph where the answer could be found. During the procedure, the students were being taught that the answers to the questions could be found with a little work with the text and their prior knowledge, a proposition that some greeted with surprise! Answers to questions were discussed and mutually agreed upon by student and investigator. On the following assessment passages, the students worked unaided and answered questions from memory, just as in the reciprocal teaching group. The locating information procedure helps younger (Raphael, Wonnocat, & Pearson, 1983) and more severely impaired (Brown & Palincsar, 1982; Lovitt & Hansen, 1976b) students improve their comprehension of texts.

The comparison between the four groups: reciprocal teaching, locating information, test only, and control is shown in Figure 6 together with the performance level set by untrained

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Insert Figure 6 about here.

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average seventh grade readers, a benchmark against which the trained students can be compared. The reciprocal teaching group improved to the level set by the average readers, but neither the locating information intervention (LI) or the test only (T) groups improved greatly during the course of the study. In fact, these groups did not differ from the control group (C), who received only baseline and maintenance tests. The reciprocal teaching intervention lead to dramatic improvement in student scores, whereas mere practice taking the tests (T), and even an intervention where the students are helped to answer comprehension questions (LI), did not result in a reliable improvement.

In our original pilot study (Brown & Palincsar, 1982), locating information helped (see also Lovitt & Hansen, 1976b; Raphael, 1980); students improved from 15 to 50% correct and maintained at 40% correct. Our explanation for these differences is that the students in the pilot study were performing so poorly initially that it is doubtful that they understood the task at all and, therefore, the locating information help was sufficient to enable them to improve somewhat. In the more extensive study (Palincsar & Brown, 1984), the students began at 40% correct, so they understood the rules of the game and the locating information intervention was just not sufficient to raise their scores significantly.

One could legitimately argue that the locating information intervention, although providing appropriate practice in test taking, did not provide any strategy training. Taken together, the control groups rule out explanations of the improvement in terms of practice, teacher attention, time on task, etc., but they do not separate out the strategy training from the reciprocal teaching element. There is a great deal of research now that suggests that explicit instruction in strategy training is necessary before any significant improvement in students' independent performance will be seen (Borkowski & Cavanaugh, 1979; Brown, Bransford, Ferrara, & Campione, 1983; Brown, Campione, & Day, 1981; Campione & Armbruster, in press). Hence, it is not the most stringent test of the reciprocal teaching procedure to compare it only to practice conditions and an intervention that does not include strategy training. Therefore, we undertook further comparisons of the reciprocal teaching procedure against other interventions that included training in the identical strategies of summarizing, questioning, clarifying, and predicting.

We have conducted three such comparison studies, the data from which are illustrated in Figure 7, where they are referred

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Insert Figure 7 about here.

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to as Studies 1, 2, and 3. In Study 1, seventh grade students, closely matched to our original sample, were assigned to each of

three conditions, where they received twelve sessions involving instruction and independent daily assessments. The three instruction groups were reciprocal teaching (RT), treated in the same manner as all our reciprocal teaching groups, modeling (M), and explicit instruction (EI). In the modeling group, the teacher modeled the four strategies on each segment of the passages and the student's role was to observe and answer the teacher-posed questions. In the explicit instruction group, the teacher demonstrated and discussed each strategy for the first half of the session; and in the second half, the students completed pencil and paper exercises in applying the strategies to the remaining text segments.

As can be seen in the left hand panel of Figure 7, all groups seemed to improve. This improvement was not statistically significant in the case of the modeling group. Furthermore, the reciprocal teaching students' performance was significantly better than that of the explicit instruction group. Explicit instruction and actual experience applying the strategies is a better procedure than teacher modeling, a procedure in which the students receive no independent practice. Far better, however, is the reciprocal teaching method where the students receive instruction, modeling, and practice, gradually taking charge of their own learning.

In the second comparative instructional study (Study 2), we used somewhat different comparison treatments. Again, we

replicated the superiority of the original reciprocal teaching procedure over other teaching methods designed to train the key strategies of summarizing, questioning, clarifying, and predicting. Seventh graders, matched as closely as possible with the original samples, were assigned to reciprocal teaching (RT), teacher modeling (M), or one of two new interventions, reciprocal teaching plus practice (RTP) or isolated skills practice (ISP). In reciprocal teaching plus practice, the students received the reciprocal teaching intervention for the first four days, and then for the remaining eight days they independently performed the strategy application after each segment of texts, writing their answers under each paragraph. In the isolated skills training condition, the students worked independently throughout, completing workbook exercises on each skill separately, with the teacher scoring their exercises and providing extensive feedback each day. These latter two interventions were designed to mimic economical and reasonable classroom practices.

Only the reciprocal teaching procedure resulted in a large and reliable gain (see Figure 7, middle panel). In the first half of training (six days), the treatment groups all showed an improvement and looked alike, with students progressing from 40% to 50% in the period. This improvement, however, was not continued in any but the reciprocal teaching group; the comparison groups remained at approximately 50%. Again, the

superiority of the reciprocal teaching procedure was demonstrated.

In the third comparative instructional study (Study 3), we recruited younger students, fifth to sixth graders, who were not diagnosed as poor readers; entry into the program was based solely on low scores (below 50% correct) on the baseline measures. Six days of training followed baseline. There were four conditions: reciprocal teaching (RT), explicit instruction (EI), practice alone (P), and a new condition called the reciprocal teaching scripted intervention (RTS). In the scripted condition, the rate of transfer from teacher to student was predetermined and constant for each child. On the first two days, the teacher was the dialogue leader and the students served as passive observers and responders to her questions. On the middle two days, the reciprocal teaching procedure was introduced with teacher and student taking turns leading the dialogues. On the final two days, the students led all the dialogues and the teacher became the pupil. Transfer from teacher to student was thereby legislated by the design of the study, not student readiness.

The data from this study are shown in the right hand panel of Figure 7. Again, only the natural reciprocal teaching procedure led to a dramatic improvement. The practice alone condition was unsuccessful. The two intermediate groups, reciprocal teaching scripted and explicit instruction, showed

reliable gains, demonstrating that explicit forms of strategy training are helpful. It is the combination of reciprocal teaching and strategy training, however, that is necessary to effect large improvement.

In summary, in several replications we have compared the reciprocal teaching procedure with viable instructional alternatives; it has always been the most effective procedure, in most cases taking the student from less than 40% up to a level of 70% to 80% correct, the level set by normal seventh grade readers. Alternate strategy training procedures that involve explicit instruction in the strategies, student practice, and teacher feedback do result in reliable improvement, but the level reached by these procedures is significantly lower than that achieved via the full reciprocal teaching method. Teacher demonstration or modeling alone, in the absence of student practice and feedback, is not a successful intervention at least over the short term. Reciprocal teaching involves teacher modeling of the key strategies and student practice. However, the unique feature of the natural form of reciprocal teaching is the gradual transfer of control to the student, a transfer dictated not by a predetermined script but by the individual student's changing "region of sensitivity to instruction" (Wood & Middleton, 1975). The interactions create a zone of proximal development tailored to each student, a zone that they need to

navigate at their own rate (Brown & Reeve, in press; Vygotsky, 1978).

Strategies. The next question that can be raised about the reciprocal teaching method is whether the entire package of summarizing, questioning, clarifying, and predicting is necessary to effect improvement or whether only some subset of the activities is sufficient. These four strategies actually consist of two important ones, summarizing and questioning, that occurred after each and every segment; and two lesser ones, clarifying and predicting; lesser because they occurred much less frequently—only when the text lent itself to these activities. Indeed, students rarely asked for clarification and it should be pointed out that the texts did not contain deliberate ambiguities of the type used in experimental studies of comprehension-monitoring (Baker, 1983; Markman, 1981). Students occasionally asked for the meaning of words: "What's the difference between soap and detergent anyway?" They sometimes demanded clarification: "I don't see how they can say 'heat lightning occurs on hot summer days.' How could you see it?" They also discussed their own errors of comprehension: "At first, I didn't get this because I thought the word, 'pumping' was 'bumping,'" and the errors they saw in the texts: "Boy, this paragraph sure is a mess. It's all over the place." Students did engage in clarifying and predicting, but not frequently enough to permit formal scoring.

Summarizing and questioning share the common purpose of forcing students to extract the gist of what they are reading, i.e., to "find the main idea," an activity beloved by teachers and reading curricula alike. Generating a synopsis of content and a reasonable test question are activities that lead students to talk about central versus peripheral content. These important activities formed the basis of the dialogues. Would they be sufficient if they were engaged in alone?

We have some preliminary data that suggest that summarizing and questioning alone would not be as effective as the full reciprocal teaching procedure. Ten days of instruction in the full reciprocal teaching method compared with reciprocal summarizing or reciprocal questioning alone resulted in the data shown in Figure 8. By reciprocal summarizing or questioning, we

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Insert Figure 8 about here.

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mean that we maintained the turn taking aspect of the reciprocal teaching procedure but all that the students needed to do was summarize or ask a question. Again, the reciprocal teaching procedure is superior to either questioning or summarizing alone, both of which do result in a reliable increase in performance, however.

The combined results of all of our laboratory studies, by which we mean studies conducted outside of the regular classroom and featuring a researcher/teacher as instructor, give impressive

support to the efficacy of using the reciprocal teaching of summarizing, questioning, clarifying, and predicting as a method of improving independent reading comprehension in the slower learning student. In the next section, we will consider attempts to hand the procedure over to classroom teachers of varying degrees of sophistication.

Reciprocal Teaching in the Classroom

Any training procedure, if it is to have practical utility, must be instructionally feasible, that is, capable of being implemented by regular teachers under conditions approaching those of the normal classroom. We attempted to test the instructional feasibility of the reciprocal teaching procedure, first with four experienced volunteer teachers, then with non-volunteer, less experienced teachers and finally with student tutors.

The students who took part in all of these studies closely matched the original sample. They were sixth to eighth graders who had achieved adequate decoding scores but who were at least two years delayed on comprehension measures.

Volunteer Expert Teachers

Our first attempt to use regular classroom teachers involved four experienced volunteers who were already meeting regularly with intact reading groups consisting of students meeting our entry criteria. Two of the groups met daily as a reading group in a normal classroom setting and the remaining groups met in a

resource room setting. The group size varied from four to seven students.

The teachers had three formal training sessions in the reciprocal teaching method. On the first day, they were introduced to the rationale behind the reciprocal teaching intervention and shown the results of the laboratory studies. They also viewed and discussed a video-tape of an expert teacher employing the technique with a group of students.

In the second training session, the teachers practiced the procedures with our guidance. We modeled both the teacher's role and behaviors that might be expected from students. Difficulties that could arise were anticipated and discussed, such as situations where a student was unable to generate a question, or where a student summarized by reiterating the whole paragraph in detail. Common remedial steps were discussed and demonstrated.

In the final session each teacher, under our guidance, practiced the procedure with a group of average seventh graders. We modeled how the procedure should be introduced to the students, the four main dialogue activities, and the process of feedback. The teacher then assumed responsibility for the group and, as the practice session transpired, discussed with us any questions they had about the method. In addition, the teachers were given sample scripts and questions to follow on the first days and directions regarding the introduction and daily format of the training sessions. We checked weekly on the teacher-

directed sessions to see if the intervention was being conducted properly. These visits provided further opportunity for discussion and resolution of any difficulties the teachers might encounter.

Because of the larger group size, the students were able to provide modeling and feedback for each other, learning from their peers as well as from their teacher. As the sessions progressed, the teacher was able to hand over a great deal of the work to the students. An illustration of this change is shown in the contrast between early and late dialogue samples, shown in Table 5 and Table 6.

Insert Tables 5 and 6 about here.

Both the early (Day 3) and late (Day 13) dialogues attest to the fact that the students (N = 5) and teacher were able to engage in a smooth flowing discussion. In the early session, however, the teacher is very much the pivotal participant. As can be seen in Table 5, one session of the silent reading is followed by one extensive dialogue, where the students interact with one another only once (statements 1 - 3); the remainder of the runs are S-T, S-T, student followed by teacher. The students interact individually with the teacher, not with each other. Note also that the entire interaction focuses on one segment of text and on one disputed point--the use of snakes' tongues. Interestingly, another group had problems with this segment, one

student reading, "No snake's tongue is completely harmless," instead of the correct, "No, - snakes' tongues are completely harmless," thus generating an interesting confusion and occasion for clarification.

The same group is seen again, ten intervention days later, in the dialogue shown in Table 6. Here, four reading-dialogue sets are included in twenty-nine statements, rather than only one as in Table 5. Now the majority of the "runs" are student-controlled, with the teacher interspersing praise, encouragement, and some management (statements 4, 10, 12, 14, 21). The teacher intercedes with advice and modeling only when a student misses the point and the other students do not catch it (statements 18, 26, 28). The teacher has moved from the pivotal role of responding individually to each child, to the role of a coach who sits in the background, offers encouragement, and occasionally pushes for a better interpretation of the text. The expert provides just the degree of scaffolding necessary for the dialogues to remain on track, leaving the students to take as much responsibility as they can.

Daily comprehension assessments. The students' individual performance was strikingly similar to that of the students in our laboratory studies (Brown & Palincsar, 1982; Palincsar & Brown, 1984). The students in three of the groups individually reached criterion within fifteen days. In the remaining group, the students reached criterion in five days. If one considers the

group means, two groups reached criterion in thirteen days, one in nine days, and one in five days. It is interesting to note that, in the most efficient group, there were only four students, two of whom were performing excellently on the first day. The resultant group, in some sense, consisted of three models, the teacher and the two good students, and two tutees, the remaining two poor students. In this favorable milieu, the poor students rapidly improved, and the entire group reached criterion in five days, versus a mean of twelve days for the other groups and for the students in the laboratory studies. Such findings, if replicated, could have important implications for decisions concerning the composition of the "optimal" reading group.

The daily comprehension means per group are shown in Figure 9. The baseline level of 40% rose steadily during training and

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Insert Figure 9 about here.

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by the fifteenth day reached an asymptote of 70-80% correct. This improvement was durable. The students also showed improvement on the transfer tests comparable to that of the subjects in the laboratory studies. These data are shown in Figure 5 as Reciprocal Teaching 2.

In summary, very similar results were found when volunteer teachers undertook the reciprocal teaching procedure in their classrooms and when an investigator conducted the intervention in

laboratory-like settings. In both cases the effect was reliable and durable, and there was transfer to tasks other than the training vehicle. The similarity of the main results across the studies is more striking than the differences. Even though the laboratory interventions were one-to-one (Brown & Palincsar, 1982), or conducted with student dyads (Palincsar & Brown, 1984) and the classroom groups were much larger, the same pattern of results obtained. Classroom teachers, receiving only a limited introduction to the method, were as effective as the investigators in conducting the intervention.

At first the teachers were quite skeptical about their students' ability to participate in the reciprocal teaching procedure. After seeing the improvement, however, they were most enthusiastic, claiming that the students were better able to locate important information and organize their ideas—skills which the teachers regarded as important "study skills." The teachers spontaneously indicated that they would add reciprocal teaching to their instructional repertoire, using it with their more capable readers as well as their poor comprehenders. Reciprocal teaching of comprehension strategies is instructionally feasible.

Non-volunteer Teachers

In response to a request from the local school authorities in the districts in which we had conducted the reciprocal teaching studies, we agreed to introduce the procedures to a

group of six remedial reading teachers as part of a regular "in-service" training. The teachers were not volunteers and varied greatly in experience. The students also varied greatly; they were seventh graders who were not receiving any other remedial help. In previous studies, students all met the Lovitt and Hansen (1976a) criteria of decoding scores of 80 to 100 words a minute with 2 or fewer errors. These students, however, had oral reading rates ranging from 64 words per minute correct with 6 words per minute incorrect to 145 words per minute correct with 0 words per minute incorrect. About 35% of the students participating in the study were minority group members. Finally, the class size averaged twelve students (range 7-15), much larger than in our previous studies.

All of the students were pretested on two measures: the ability to write summaries and the ability to predict the kinds of questions classroom teachers ask. Following pretesting and a baseline period of five days, each of the six teachers began the reciprocal teaching intervention with one experimental group and continued their regular program of instruction with their control group. Altogether, there were 70 students in the six experimental groups and 71 in the six control groups. Following approximately twenty days of training, the students entered a five day maintenance period followed by the posttests. During each day of the study, the students in the experimental and control groups read an assessment passage independent of the

training material and answered accompanying comprehension questions from memory, just as in our previous studies.

The difference between the reciprocal teaching condition and the control condition was again reliable, even under these less than favorable circumstances. The data are shown in Figure 10. Even with these large and disparate groups, the reciprocal teaching procedure proved effective.

Insert Figure 10 about here.

It is important to note that average classroom teachers can introduce the procedure into reading groups that consist of ten or more students. Furthermore, we have evidence that the procedure can be adapted to include the whole classroom. For example, teachers have used a modified version of reciprocal teaching to direct portions of their seventh grade science classes. The number of students in these classes made the oral turn-taking of reciprocal teaching unwieldy. In its place was substituted a procedure whereby the students and teacher read the text silently and after each segment privately wrote down a summary, question, clarification, and prediction. After several segments had been covered, the teacher asked students to volunteer their responses and wrote several candidate summaries (questions, clarifications, and predictions) on the board. Then the students as a group debated the merits of each until they reached a degree of consensus on the most appropriate version.

Over the term the students showed marked improvement on their written versions of the four activities and their classroom participation. In addition, the students improved significantly on daily independent tests of comprehension (from 57% to 75% correct).

Peer Tutors

Considerable evidence supports the conclusion that peer and cross-age tutoring help both tutors and tutees. Cross-age tutoring has been used to enhance written expression (Drass & Jones, 1971), math skills (Greenwood, Sloane, & Baskin, 1974; Harris & Sherman, 1973; Johnson & Baily, 1974), and spelling (Jenkins, Mayhall, Peschka, & Jenkins, 1974). Peer tutoring has resulted in improved sight vocabulary (Parson & Howard, 1979) and increased accuracy and rate of math computation (Kane & Ally, 1980). Given these encouraging data, we decided to see if peers could handle the reciprocal teaching procedure.

We asked three teachers who had served as reciprocal teachers in the past to supervise nine tutors, selected because, even though they were remedial readers, they scored well on our baseline assessments (70% correct). The teachers trained the tutors in the reciprocal teaching procedure and then assigned them one or more tutees who were performing poorly (40% or below) on baseline measures. There were three teachers, nine tutors, and sixteen tutees. The teachers supervised the tutoring sessions, giving aid and answering questions when needed.

The tapes from these tutoring sessions are still being transcribed and the pre- and posttest data are not yet scored. However, the results of the daily assessments are encouraging. These data are presented in Figure 11, where it can be seen that peer tutoring can promote comprehension skills quite effectively. By the second half of intervention, the tutors were able to bring the scores of their tutees up to 70% correct, not far short of the level achieved by professional teachers.

Insert Figure 11 about here.

This is an interesting finding as the tutors did not appear to be gifted teachers; they lacked a certain amount of tact, responding to their tutees' efforts somewhat bluntly: "Boy, that's picky," "Are you reading the same thing I am?", etc. In addition, they often gave inadequate feedback, accepting less than perfect contributions from their students. But what they did do well was model the four activities, at times even going to the extent of signalling their contributions explicitly (Now I am summarizing, here is my question, this is my clarification, etc.). And we cannot stress enough that the teachers offered support and encouragement, settling disputes and entering discussions as they circulated among the groups. The tutors gained enormous satisfaction from "being the tutor"; they came to class ahead of time to prepare materials and took their responsibilities very seriously. Given the tutors' enthusiasm,

and the acceptable level of improvement of the tutees, it would seem that reciprocal peer teaching is a worthwhile enterprise.

One of our long term aims is to devise a complete classroom intervention module for use in mainstreamed classroom settings. Teachers trained in the reciprocal teaching method will conduct the reading groups in this manner. While teachers are thus engaged, the remaining students will be working on microcomputer or workbook exercises that will include practice on the four strategies of summarizing, questioning, clarifying, and predicting. These materials will be programmed in nature so that they can be used in worksheet format at students' desks, in learning centers, or at computer terminals. For example, a student who is experiencing difficulty learning to generate questions would work on a unit of carefully sequenced questioning activities. Less capable readers would use the work station materials as remedial work to bolster the practice received in reading group. More capable students would use these centers to further hone their skills. For example, they could construct study guides that the less capable students might use to complement a science or history text; for each section of the text, the competent student might generate several questions, summarize, and emphasize content which might be unclear to less competent students. The more capable students could also tutor weaker students at the work station when the teacher is conducting reading instruction with the average readers. Peer

interactions at work stations have been shown to be an effective part of the Kamehameha Early Education Program (Tharp et al., in press), where a central place is given to classroom social interactions in the acquisition of reading skills.

Reciprocal Teaching Across the Curriculum

We see no reason in principle why expert scaffolding procedures such as reciprocal teaching cannot be used in domains other than reading instruction. Indeed, the procedure evolved as a concrete version of more general teaching methods designed to augment critical thinking skills. The dialogues were intended to function as a simplified and structured version of a Socratic dialogue (Collins & Stevens, 1982) involving systematic, sequenced, structured guidance in questioning, arguing, and disputing the evidence in the text. It was intended that over time, these activities of critical thinking would become internalized as part of the child's own general repertoire of learning skills. In short, we have always regarded the procedure as a form of general education in thinking critically rather than a specific form of reading instruction.

Reciprocal teaching is a form of expert scaffolding. Expert scaffolding is the instructional philosophy that lies behind successful instruction by: (a) computers in such areas as physics (Heller & Hungate, 1984), electronics trouble-shooting (Brown, Burton & deKleer, 1982), and early mathematics (Feurzig & White, 1984); (b) teachers in story telling (McNamee, 1981) and writing

(Applebee & Langer, 1983; Scardamalia, 1984); (c) peers in study strategies and problem solving (Bloom & Broder, 1950; Frase & Schwartz, 1975); and (d) parents in picture book reading (Ninio & Bruner, 1978), counting (Saxe, Gearhart & Guberman, 1984), and problem solving (Wertsch, 1979). The idea of gradual transfer of strategic control from expert to novice is a crucial feature of the informal teaching and learning that occurs in natural tutoring situations, between parent and child, mastercraftsman and apprentice, or teacher and student.

Reciprocal Teaching of Arithmetic Reasoning

Consider how one might apply the procedure to mathematics. Something like this has already been undertaken by Open Court Publishing Company in their Real Math Series (Willoughby, Bereiter, Hilton, & Rubinstein, 1981), which contains thinking stories like the one shown in Table 7. In the story, Ferdie

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Insert Table 7 about here.

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and Portia, visiting their grandfather's farm, are attempting to count the new piglets, some of whom are pink, some black, and some piebald. The students read along until the teacher stops them with queries at predetermined stages (queries in upper case). The problems are meant to stimulate a discussion, a discussion that in this example centers on basic counting principles such as those described by Gelman and Gallistel (1978). For example, the second of Ferdie's mistakes is a

violation of the one-to-one correspondence rule and Portia's first mistake is a violation of the abstraction principle, that counting can be independent of categories. The last probe tests for knowledge of the cardinality rule. We intend to use the reciprocal teaching procedures with such thinking stories to train simple arithmetic and logical reasoning skills in young children, with the children taking turns to summarize, discuss, clarify, and detect errors of reckoning and reasoning.

Reciprocal Teaching of Listening Comprehension

Our most ambitious extension of reciprocal teaching has been to the closely related field of listening comprehension where we have worked with much younger students. Ten first graders were assigned to a reciprocal teaching group; they were selected because they were nominated by their teachers as poor listeners, a diagnosis that was confirmed by their scores on the listening subtests of the Durrell Analysis of Reading Difficulty. In addition, the students performed poorly on our baseline measures of listening comprehension.

The general procedure was similar to that used in the reading studies. The students worked in pairs with the teacher on one set of materials and were independently tested for their comprehension of another set of materials. During the dialogues the teacher began by reading the title of the passage and asking the students what they thought they might learn from a story with this title. She then read the first paragraph aloud and modeled

five activities: summarizing (stating what the segment was about), generating a question, probing for requests for clarifications ("Did anyone find there was something in this part that was hard to understand?")--asking for clarification ("What do they mean when they say . . . "), and making predictions. On the next segment, a student was guided through the procedure as he or she attempted to assume the role of teacher.

After the twenty minutes of instruction, the students were administered a novel assessment passage on an individual basis. The testers read these passages orally. The only difference from the original reading studies was that questions were interspersed throughout the text, rather than massed at the end after the entire passage had been read.

Reciprocal teaching of listening comprehension was compared with two other groups. The first was a test only group (T) who received all of the daily assessments but no intervention. The second group, explicit instruction (EI), received all of the tests and instruction. This consisted of the teacher modeling the four strategies, but the students did not take turns leading the dialogue. These comparison groups were directly comparable to those used previously in our reading comprehension studies.

The two interventions were clearly better than the test only group, who did not improve. But at first sight the two intervention groups did not differ from one another. These data are shown in the left hand panel of Figure 12. However, even

Insert Figure 12 about here.

cursory inspection of the dialogues revealed that two students in the reciprocal teaching group did not succeed in taking their turn as dialogue leader; these students failed to improve on the independent assessments. In addition, half way through the procedure, two students in the explicit instruction group rebelled against their passive status and began creating a dialogue with the teacher. They interpolated summaries, questions, clarifications, and predictions of their own, thereby converting their group into a spontaneous reciprocal teaching group. They subsequently outperformed the other students on the daily assessments. If we omit the two spontaneous reciprocal teaching students from the explicit instruction group and the two reciprocal teaching students who never caught on to the procedure, we get the pattern shown in the right hand panel of Figure 12. Very similar to the reading results, there is a significant improvement for both reciprocal teaching and explicit instruction, but the difference between these two interventions is large and reliable. Given the short period of instruction (10 days), the small number of subjects, and the necessity of reclassifying subjects in order to fully reveal the effect, we are currently replicating the study with a second group of suitable first graders. In addition, the reciprocal teaching

listening procedure is currently being used by eight regular first grade teachers in their normal classroom settings.

We believe that techniques such as reciprocal teaching could be introduced widely across the curriculum. The general philosophy is a two level approach to teaching. Instruction should simultaneously introduce the content to be mastered and the thinking processes that will ensure that mastery. The student should be charged with acquiring the ways of thinking and problem solving within the domain as well as the content knowledge. Within each subject area, students should observe and practice the domain appropriate strategies, receive direct experience in the orchestration, overseeing, and monitoring of those strategies, and be constantly reminded of the significance of the activities and their range of utility (Brown, Campione & Day, 1981). We believe that the two-level approach would result in improvement in both critical thinking skills and content mastery.

Reciprocal Teaching and Special Populations

The reciprocal teaching method is applicable to a wide age and ability range. Although the original program of research was conducted with below average junior high school students, it has also been used successfully with gifted third graders and learning disabled college students. Expert modeling followed by student practice on the explicit rules underlying critical reading has resulted in successful interventions with first

graders (Au & Kawakami, in press), normal high school students (Bird, 1980), and junior college students with and without diagnosed reading problems (Day, 1980). Situations where pairs of college students take turns talking-aloud about their problem solving processes, with one member of the pair acting as problem solver and the other as critic have improved reading (Frase & Schwartz, 1975), studying (Bloom & Broder, 1950), and problem solving (Whimbey & Lochhead, 1982).

Reciprocal teaching of reading comprehension can be used with students at the lower end of the normal IQ range, as long as their decoding fluency permits independent silent reading. It is true that our only failure to date, Student 2 (Dora), had a low IQ (67). But it is also true that one of our conspicuous successes, Charles (see Table 3), also had a low IQ (70). Whereas Dora did not reach criterion on the daily assessments and failed to show transfer, Charles reached a level of 80% correct, maintained this level for eight weeks after training ceased, transferred across tasks and settings, and dramatically improved his standardized scores. Low IQ is not necessarily an impediment to learning.

We do have some preliminary data that suggests with low functioning students such as Dora, who begin the intervention scoring as low as 10% correct, a more gradual introduction of the strategies might be the most appropriate procedure. For such students, the best procedure seems to be to introduce reciprocal

summarizing first and then add the other components as each individual strategy is mastered.

The extension of the procedure to listening comprehension will also enable us to reach much more severely impaired students; students whose decoding problems compound their comprehension difficulties. The need for a comprehension-based training program for educably retarded children is clear, for poor readers are often poor listeners and poor learners. Via listening, comprehension-fostering and monitoring procedures could be introduced to slow learning students and then, by a process of shaping, the reciprocal listening procedure could also serve as a vehicle through which to gradually introduce the child to strategies of reading comprehension.

There is also the matter of early detection and prediction. Another reason for extending the procedure to listening comprehension concerns the possibility that the child with problems of listening in first grade may subsequently become the poor reader. Early intervention might forestall some of the potential delay. Psychometric studies clearly indicate that by fifth grade, listening comprehension scores are excellent predictors of academic success (Humphreys & Parson, 1979). And by third grade, scores on standardized listening comprehension tests are the best predictors of subsequent reading efficiency (Curtis, 1980). Before this period, however, listening comprehension scores do not predict reading well; the better

predictor is decoding speed and accuracy (Curtis, 1980). However, there is a problem with interpreting this age effect. Before grade three, tests of reading competence are heavily biased toward tests of decoding and, therefore, it is not surprising that independent tests of decoding predict reading, which itself is measured primarily by tests of decoding. In addition, tests of listening comprehension before grade three leave much to be desired, often measuring something other than comprehension, for example, rote memory.

In addition to the controversial nature of the listening items, there is the general problem that many of the tests are discontinuous across ages. Tests of listening comprehension at age five do not look like tests of listening comprehension at age ten; therefore, it is unlikely that performance at the earlier age would predict later success. By extending the reciprocal teaching procedure to listening, we are able to use the identical strategies and procedures in both listening and reading, and, therefore, we should have a better basis for prediction. In short, if we can diagnose a comprehension problem early in a child's academic career using a listening task, this information might (a) help us to predict who will have subsequent reading comprehension problems on a similar reading task, and (b) enable us to provide training before the child experiences extensive failure in reading settings, with all the attendant problems such failure portends (Brown, Palincsar, & Purcell, in press). Thus,

while the extension to listening is important in its own right, the possibility of predicting and even preventing reading comprehension problems is truly exciting.

Reciprocal Teaching and Critical Thinking Skills

In this report, we have traced the natural history of one program of research designed to enhance learning. Beginning with a small laboratory demonstration, the program led to more ambitious instructional attempts involving a greater variety of teachers, students, subject matter, and settings. While implementing and extending the program in practical settings, we also conducted basic research on both the strategies themselves and the means of instruction. The program is guided both by consideration of theory and consideration of practice, notably that of diagnosis and remediation.

We would like to end by reiterating why we believe that the reciprocal teaching procedure has proved so successful compared with the outcomes of other viable interventions (Brown & Campione, 1978, 1981; Chipman, Segal & Glaser, in press). First note that this is an example of "informed, self-control training" (Brown, Campione, & Day, 1981; Brown, Bransford, Ferrara, & Campione, 1983); the students are fully informed of everything we, the investigators, know about the strategies (or almost everything). The students know why, when, and where they should use the strategies, and that if they should choose to be

strategic, their performance will improve. Aware of the pool of strategies at their disposal, they have a chance to apply them, to monitor the efficiency with which they do so, and to recruit fix-up strategies when they detect a comprehension failure.

The students achieve this self-control by internalizing or incorporating into their repertoires activities that they first saw an expert model, and that they first engaged in themselves with a great deal of social support. The teacher not only modeled the activities, rendering them overt, explicit and concrete, but she also attempted to transfer components of the strategies to the students as soon as they were able to handle some of the responsibility. Gradually, accomplishing a series of small successful steps along the way, the students assumed a more mature role. The strategies were practiced with the clear goal of understanding and remembering texts. Feedback did not consist simply of information that some attempt was judged correct or incorrect by the teacher; instead it provided information that comprehension of the text, here and now, was actually occurring.

The reciprocal teaching procedure, with its social support for novices' efforts, and its gradual transfer of responsibility to the child, is a classic example of adult scaffolding, identified by Bruner (1978) as a key element in the acquisition of language by young children. Such scaffolding is also central to many naturally occurring teaching situations. For example,

Greenfield (1984) described six features common to language acquisition and learning to weave, that share a great deal with the reciprocal teaching procedure: (a) the degree of aid, or scaffolding, is adapted to the learner's current state; (b) the amount of scaffolding decreases as the skill of the learner increases; (c) for a learner at any one skill level, greater assistance is given if task difficulty increases, and vice versa; (d) scaffolding is integrated with shaping, i.e., local correction and aid are given in response to the child's current performance; (e) the aid or scaffolding is eventually internalized, permitting independent skilled performance; and finally (f) the teachers appear to be generally unaware of their teaching function. In reciprocal teaching, the instructional role is quite explicit; but Greenfield's remaining five elements describe the procedure quite well.

Finally, reciprocal teaching emerged from our long-time interest in basic argument skills that underlie flexible and inventive learning (Brown & Campione, 1981, 1984). The procedure was designed to be a simplified, concrete version of essential critical thinking skills, with the teacher modeling the types of processes we believe that expert learners engage in frequently on their own volition. Mature learners do engage in periodic self-review, questioning the veracity of what they are studying. They seek clarification of inconsistency internal to the text; they question information that is incompatible with extant knowledge;

they engage in a variety of knowledge-extending and -refining ploys, arguing with themselves via an internal dialogue. It is these internal dialogues that we attempted to externalize in the reciprocal teaching procedures in order to provide weaker students with a model of critical thinking.

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[2] In the first laboratory studies published in Brown & Palincsar (1982) and Palincsar & Brown (1984), Palincsar served as the expert teacher. In subsequent laboratory style studies, she shared the load with Ms. Debbie Dunn and Ms. Melinda Samsel who served as master teachers for the development of the procedure. The authors extend their appreciation for their excellent collaboration.

Table 1

Examples of Student Generated Questions During Reciprocal Teaching

First Half of Training

Questions Requiring Clarification (and Ideal Questions Regarding the Same Materials and Ideas)

What was uh, some kings were uh, about the kings? (Why is it that kings did not always make the best judges?)
What were some of the people? (What kinds of people can serve on a jury?)
What was the Manaus built for? Wait a minute. What was the Manaus built for, what certain kind of thing? Wait a minute. O.K. What was the Manaus tree built for? (Why was the city of Manaus built?)
What does it keep the ground? (What effect does snow have on the ground?)
What are the Chinese people doing today, like ... What are they doing? (Why are the Chinese people rewriting their alphabet today?)
There's you know, like a few answers in here and one of my questions is, uh, anything that burns and explodes can be fast enough to ... See, they got names in here. O.K.? (Name some explosives.)
In Africa, India, and the Southern Islands where the sun shines what happens to the people? You know, like ...? (Why do people who live in Africa, India and the Southern Islands have dark skin?)

Detail Questions (and Ideal Main Idea Questions on the Same Material

Do water moccasins have a joint in their eyes - nostrils - which they are able to - they are sensitive to? (How is a water moccasin able to tell that a warm blooded animal is near?)
How many backbones can a snake have? (What is unusual about the vertebrae of a snake?)
The western corral is only a blank, blank, and blank long. (Name an important characteristic of the western coral snake.)
How do camels spread out in a line? (What is a caravan?)
Do most of the people when they get camels, save them or do they try to get rid of them? (In what ways are camels useful to people who live in the desert?)
What color is the guard's uniform? (What would you see if you were visiting Buckingham Palace?)

Second Half of Training

Main Idea Questions

Where does lightning get its charge?
When a larva reaches its full size, what does it become?
Where does the pitcher plant grow and why does it grow there?
How do you know that the winds are really strong in Antarctica?
Why would scientists go to Antarctica?
What does hemoglobin do?
Why don't people live in the desert?
Why are the grasslands of Australia ideal for grazing?
What did these people (the Chinese) invent?
What are three main problems with all submarines?

Table 2

Examples of Student Generated Summaries during Reciprocal Teaching

First Half of Training

Incomplete Summaries (and Suggested Appropriate Summaries)

They talk about it was the richest island; but it didn't have something, O.K., it was the richest island but didn't have everything. They didn't have something. (Although this was a very rich land, no people lived there.)

If you pick a cherry branch in the winter you will have luck hoping they will bloom early. (If you pick a cherry branch in the winter, you will have no luck with it blooming.)

And uranium can be making explosion that equals a skyscraper. (A small amount of uranium can cause an explosion as great as a skyscraper full of dynamite.)

What camels do... (Camels are invaluable to the people of the desert.)

Snakes can move forward and backward and they have a rubbery something. (A snake's flexibility is due to its unusual backbone, which consists of many vertebrae connected by loose rubbery tissue.)

Detailed Summaries (and Suggested Appropriate Summaries)

It's about the coral snake. It's about how long the coral snake is and the western coral snake. And the next, they're harmful, except for fangs are too short to go through heavy clothes or shoes. (This paragraph describes the physical characteristics of the common and western coral snakes.)

I can summarize. It's about like the full grown spider, when it wants to travel it has to use all eight legs and the much younger ones have to use posts, bushes, and fence posts, and posts, and leaf stems. And it tells you like when the wind blows how the young spiders hold onto their streamers. (This paragraph describes two methods by which spiders travel from one location to another.)

Second Half of Training

Main Idea Summaries

It's about how Hawaii is a chain of undersea volcanoes and about the myth of how they were formed.

This is about lightning flashes and that it's caused by two different clouds.

This one is mainly about the stages of the butterfly.

This is all about how the venus fly trap lures and captures its victim.

I would summarize it by saying that this tells about the red blood cells and the hemoglobin that carries gasses around.

This is about how crows communicate with each other.

It tells us about the two kinds of camels, what they are like and where they live.

Table 3

The Acquisition of Question-Asking by a Weak Seventh Grade Student (Charles)

Day 1:

TEXT: The water moccasin, somewhat longer than the copperhead, is found in the southeastern states. It lives in swampy regions. It belongs, as do also the copperhead and the rattlesnakes, to a group of poisonous snakes called pit vipers. They have pits between their eyes and their nostrils which, because they are sensitive to heat, help the snakes tell when they are near a warm-blooded animal. Another name for the water moccasin is "cottonmouth." This name comes from the white lining of the snake's mouth.

1) S: What is found in the southeastern snakes, also the copperhead, rattlesnakes, vipers - they have. I'm not doing this right.
2) T: All right. Do you want to know about the pit vipers?
3) S: Yeah.
4) T: What would be a good question about the pit vipers that starts with the word "why?"
5) S: (No response)
6) T: How about, "Why are the snakes called pit vipers?"
7) S: Why do they want to know that they are called pit vipers?
8) T: Try it again.
9) S: Why do they, pit vipers in a pit?
10) T: How about, "Why do they call the snakes pit vipers?"
11) S: Why do they call the snakes pit vipers?
12) T: There you go! Good for you.

Day 4:

TEXT: Spinner's mate is much smaller than she, and his body is dull brown. He spends most of his time setting at one side of her web.

13) S: (No question)
14) T: What's this paragraph about?
15) S: Spinner's mate. How do spinner's mate...
16) T: That's good. Keep going.
17) S: How do spinner's mate is smaller than...How am I going to say that?
18) T: Take your time with it. You want to ask a question about spinner's mate and what he does, beginning with the word "how."
19) S: How do they spend most of his time sitting?
20) T: You're very close. The question would be, "How does spinner's mate spend most of his time?" Now, you ask it.
21) S: How does spinner's mate spend most of his time?

Table 3 (cont'd.)

Day 7:

TEXT:

> Perhaps you are wondering where the lava and other volcanic products come from. Deep within our earth there are pockets of molten rock called magma. Forced upward in part by gas pressure, this molten rock continually tries to reach the surface. Eventually--by means of cracks in the crustal rocks or some similar zone of weakness--the magma may break out of the ground. It then flows from the vent as lava, or spews skyward as dense clouds of lava particles.

22) S: How does the pressure from below push the mass of hot rock against the opening? Is that it?
23) T: Not quite. Start your question with, "What happens when?"
24) S: What happens when the pressure from below pushes the mass of hot rock against the opening?
25) T: Good for you! Good job.

Day 11:

TEXT:

> One of the most interesting of the insect-eating plants is the Venus's flytrap. This plant lives in only one small area of the world — the coastal marshes of North and South Carolina. The Venus's flytrap doesn't look unusual. Its habits, however, make it truly a plant wonder.

26) S: What is the most interesting of the insect eating plants, and where do the plants live at?
27) T: Two excellent questions! They are both clear and important questions. Ask us one at a time now.

Day 15:

TEXT:

> Scientists also come to the South Pole to study the strange lights that glow overhead during the Antarctic night. (It's a cold and lonely world for the few hardy people who "winter over" the polar night.) These "southern lights" are caused by the Earth acting like a magnet on electrical particles in the air. They are clues that may help us understand the Earth's core and the upper edges of its blanket of air.

28) S: Why do scientists come to the south pole to study?
29) T: Excellent question! That is what this paragraph is all about.

Table 4

Improvement in Question-Asking by a More Competent Seventh Grade Student (Sara)

Day 2:

TEXT: HOW CAN SNAKES BE SO FLEXIBLE?

> The snake's skeleton and parts of its body are very flexible--something like a rubber hose with bones. A snake's backbone can have as many as 300 vertebrae, almost ten times as many as a human's. These vertebrae are connected by loose and rubbery tissues that allow easy movement. Because of this bendable, twistable spinal construction, a snake can turn its body in almost any direction at almost any point.

1) S: Snakes' backbones can have as many as 300 vertebrates - almost _ _ _ times as many as humans.
2) T: Not a bad beginning, but I would consider that a question about a detail. Try to avoid "fill in the blank" questions. See if next time you can fine a main idea question and begin your question with a question word - how, why, when....

Day 3:

TEXT:

> There are snakes in nearly all parts of the world. Some snakes prefer warm, arid desert areas. Others prefer leafy forests, fields, and woodlands. Some stay in areas near water and are fine swimmers. Then there are several varieties that live all their lives in the sea.

3) S: Can snakes live their whole lives in seas?
4) T: See if you can ask a question using your own words.

Day 4:

TEXT:

> The other kind of camel--the one with two humps--is the Bactrian. Its home country is the Gobi Desert of northeastern Asia. The Bactrial has shorter legs and longer wool than the one-humped camel. It also has stronger, more rugged feet. This is important because instead of having sand to walk on, the Bactrian camels live in rough and rocky parts of the world.

5) S: Where is the Bactrian found?
6) T: Good for you.

Table 4 (cont'd.)

Day 6:

TEXT:

> When most full-grown spiders want to travel, they have to walk on their eight legs. But some small kinds of spiders, and many young ones, use an easier way. They climb up on bushes, fence posts, or weed stems and spin streamers of silk. When the wind catches the silk and blows it away, each spider tightly holds onto his own streamer. The silk streamer carries him through the air as if it were a parachute or a balloon.

7) S: I think I have another. When it's traveling, what do they compare the spider to?
8) T: An interesting question.

Day 11:

TEXT:

> The young caterpillar's first meal is its own eggshell. Then it eats a leaf and each day eats more and more food. After a few days, the caterpillar becomes too large for its skin. A new skin forms beneath the first one, the old skin comes open and, like a snake, the caterpillar wriggles its way out of the split skin. Then the caterpillar goes on eating leaves or other kinds of food. When the new skin becomes too tight for the growing body, it again splits and comes off. By then the caterpillar is covered by another skin. This eating and shedding goes on for several weeks. The old skin may be replaced by a new one four or five times. Each time the skin is shed, the size and color of the caterpillar change.

9) S: Why does the caterpillar's skin split?
10) T: Excellent question. That was the point of the entire paragraph.

Table 5

Reciprocal Dialogue from an Early Session; Study 2, Group 3, Day 3.

TEXT:

> CAN SNAKES STING WITH THEIR TONGUES?
> No--snakes' tongues are completely harmless. They're used for feeling things and for sharpening the snakes' sense of smell. Although snakes can smell in the usual way, the tongue flickering in the air picks up tiny particles of matter. These particles are deposited in two tiny cavities at the base of the nostrils to increase the snakes's ability to smell.

1. A: Do snakes' tongues sting?
2. K: Sometimes.
3. A: Correct.
   This paragraph is about do snakes sting with their tongue, and different ways that the tongue is for and the senses of smell.
4. *T: Are there any questions?
5. C: Snakes' tongues don't sting.
6. *T: Beautiful! I thought, boy, I must have been doing some fast reading there because I missed that point. A_____, could you ask your question again?
7. A: Do snakes' tongues really sting?
8. *T: Now, A_____, since you have asked the question, can you find in that paragraph where the question in answered?
9. A: No, snakes' tongues are completely harmless.
10. *T: So we'll try it again. Can you generate another question that you think a teacher might ask?
11. A: What are the tongues used for?
12. *T: Good!
13. L: The sense of smell.
14. *T: Is that correct? A_____, do you disagree? Yes.
15. A. That answer was right, but there are other things that the tongue can do.
16. L: But she only said tell one, she didn't say tell all of them.
17. *T: O.K.
18. B: It is used to pick up tiny particles.
19. *T: O.K. I think that this is an important point. You have the basic concept which is correct, O.K., but what the question really is saying is, is it used for smell? O.K.?
20. B: They are used for feeling things for sharpening snakes' sense of smell.
21. *T: O.K. They are used for sharpening the snakes' sense of smell. Are they used for smelling? That's the point we aren't clear on.
22. L: In my answer I said it is for the sense of smell.
23. *T: This is fine; this is what the technique is all about. What it means is not that you are right or wrong or good or bad. What it says is that we have just read something and have had a disagreement about what it says. We need to work it out.
24. A: My prediction is that they will now talk about the different things about snakes. Where they live, and what they eat and stuff like that.
25. *T: O.K. Good. What do you think they eat?
26. A: Animals.
27. A: Deserts.
28. C: I challenge. Snakes, all of them, don't live in the desert. They live in the woods and in swamp areas.

---

* Indicates turns taken by adult teacher

Table 6

Reciprocal Dialogue from a Later Session; Study 2, Group 3, Day 13.

TEXT: In the United States salt is produced by three basic methods: solar (sun) evaporation, mining, and artificial heat evaporation. For salt to be extracted by solar evaporation, the weather must be hot and dry. Thus, solar salt is harvested in the tropic-like areas along our southern ocean coasts and at Great Salt Lake.

1. C: Name three different basic methods how salt is produced.
2. A: Evaporation, mining, evaporation ... artificial heat evaporation.
3. C: Correct, very good. My summary on this paragraph is about ways that salt is being produced.
4. *T: Very good. Could you select the next teacher?
   (Student selects another student)

TEXT: The second oldest form of salt production is mining. Unlike early methods that made the work extremely dangerous and difficult, today's methods use special machinery, and salt mining is easier and safer. The old expression "back to the salt mine" no longer applies.

5. L: Name two words that often describe mining salt in the old days.
6. K: Back to the salt mines?
7. L: No. Angela?
8. A: Dangerous and difficult.
9. L: Correct. This paragraph is all about comparing the old mining of salt and today's mining of salt.
10. *T: Beautiful!
11. L: I have a prediction to make.
12. *T: Good.
13. L: I think it might tell when salt was first discovered, well, it might tell what salt is made of and how it's made.
14. *T: O.K. Can we have another teacher?

TEXT: Table salt is made by the third method -- artificial evaporation. Pumping water into an underground salt bed dissolves the salt to make a brine that is brought to the surface. After purification at high temperatures, the salt is ready for our tables.

15. K: After purification at high temperatures the salt is ready for what?
16. C: Our tables.
17. K: That's correct. To summarize: After its purification, the salt is put on our tables.
18. *T: That was a fine job, Ken, and I appreciate all that work, but I think there might be something else to add to our summary. There is more important information that I think we need to include. This paragraph is mostly about what?
19. A: The third method of artificial evaporation.
20. B: It mainly tells about pumping water from an underground salt bed that dissolves the salt to make a brine that is brought to the surface.
21. *T: Angela hit it right on the money. This paragraph is mostly about the method of artificial evaporation and then everything else in the paragraph is telling us about that process. O.K. Next teacher.

Table . (cont' d)

TEXT: For thousands of years people have known salt--tasting it, using it for their lives' needs. Sometimes it has been treasured as gold; other times it has been superstitiously tossed over the shoulder to ward off bad luck. Somehow people and salt have always been together, but never is the tie more complete than when the best people are called "the salt of the earth."

22. C: My question is, what are the best people called?
23. L: The salt of the earth.
24. C: Why?
25. L: Because salt and the people have been together so long.
26. *T: Chris, do you have something to add to that? O.K. It really isn't because they have been together so long; it has to do with something else. Brian?
27. B: (reading) "People and salt have always been together but never has the tie been so complete."
28. *T: Allright, but when we use the expression, "That person is the salt of the earth," we know that means that person is a good person. How do we know that?
29. B: Because we treasure salt, like gold.

---

* Indicates turns taken by adult teacher

Table 7

An Excerpt From an Open Court Thinking Story.

Dialogue

"How many piglets are there?" asked Portia.

"Count them yourselves," said Grandfather with a smile, "if you can."

"Of course I can count them," said Ferdie. "That's easy."

Ferdie crouched down beside the pen and counted the piglets as they ran past. He counted, "1, 2, 3, 5 . . ."

"You made a mistake," said Portia.

What mistake did Ferdie make?

What should he have said?

"You skipped 4," said Portia.

"All right," said Ferdie, "I'll start again."

This time he didn't skip any numbers. Every time a piglet ran past, he counted. He counted, "1, 2, 3, 4, 5, 6, 7, 8, 9, 10." Then he shouted, "Ten piglets! That's a lot!"

"H'm," said Grandfather, "I didn't think there were that many."

Could Ferdie have made a mistake? How?

"I think you counted some piglets more than once," said Portia. "You counted every time a piglet ran past, and sometimes they came past more than once. Let me try."

Portia looked into the pen, where the piglets were still running around. She said, "There's a pink one. That's 1. There's a black one. That's 2. There's a spotted one. That's 3. And, oh, there's one with a funny tail. That's 4. Martha has 4 piglets."

"You did that wrong," said Ferdie. "You didn't count all the piglets."

How could Portia have made a mistake?

"You counted only 1 pink one," said Ferdie, "and there's more than 1 pink one. See? And there's more than 1 black one, too. I don't know how many piglets there are. I wish they'd stand still so we could count them."

"Just wait," said Grandfather. "Maybe they will."

In a little while Martha finished eating and lay down on her side. The piglets stopped running around. They went over to their mother and started feeding.

"Now we can count them," said Portia. "They're all in a row." She counted, "1, 2, 3, 4, 5."

How many piglets did she count? (5)

Note. From How Deep Is the Water? A Real Math Thirking Story Book (pp. 3-4) by S. S. Willoughby, C. Bereiter, P. Hilton, & J. H. Rubinstein, 1981, La Salle, IL: Open Court Publishing Company. Copyright 1985, 1981, by Open Court Publishing Company. Reprinted by permission.

Figure Captions

Figure 1. Changes in questioning behavior during the interactive dialogues. (from Brown & Palincsar, 1982)

Figure 2. Changes in summarization during the interactive dialogues. (from Brown & Palincsar, 1982)

Figure 3. Daily independent assessment scores of six reciprocal teaching students. (from Palincsar & Brown, 1984)

Figure 4. Classroom generalization test of the reciprocal teaching (RT) and control (C) students in science and social studies classes. (from Palincsar & Brown, 1984, Study 1)

Figure 5. Examples of the type of improvement found on the laboratory transfer tests in Palincsar & Brown, 1984. RT1 = the laboratory study, RT 2 = the volunteer teacher study, C = untreated matched control students and A = average seventh graders with no identified learning or reading problems.

Figure 6. A comparison between the reciprocal teaching (RT) and locating information (LI) interventions and a variety of control groups. (from Palincsar & Brown, 1984, Study 1)

Figure 7. A comparison between reciprocal teaching and several alternative instructional procedures: brief reciprocal teaching and practice (RTP); reciprocal teaching, scripted rather than naturally determined (RTS); explicit instruction (EI), all of which resulted in reliable improvement; and modelling (M), individual skills practice and practice alone, all of which did not result in reliable improvement.

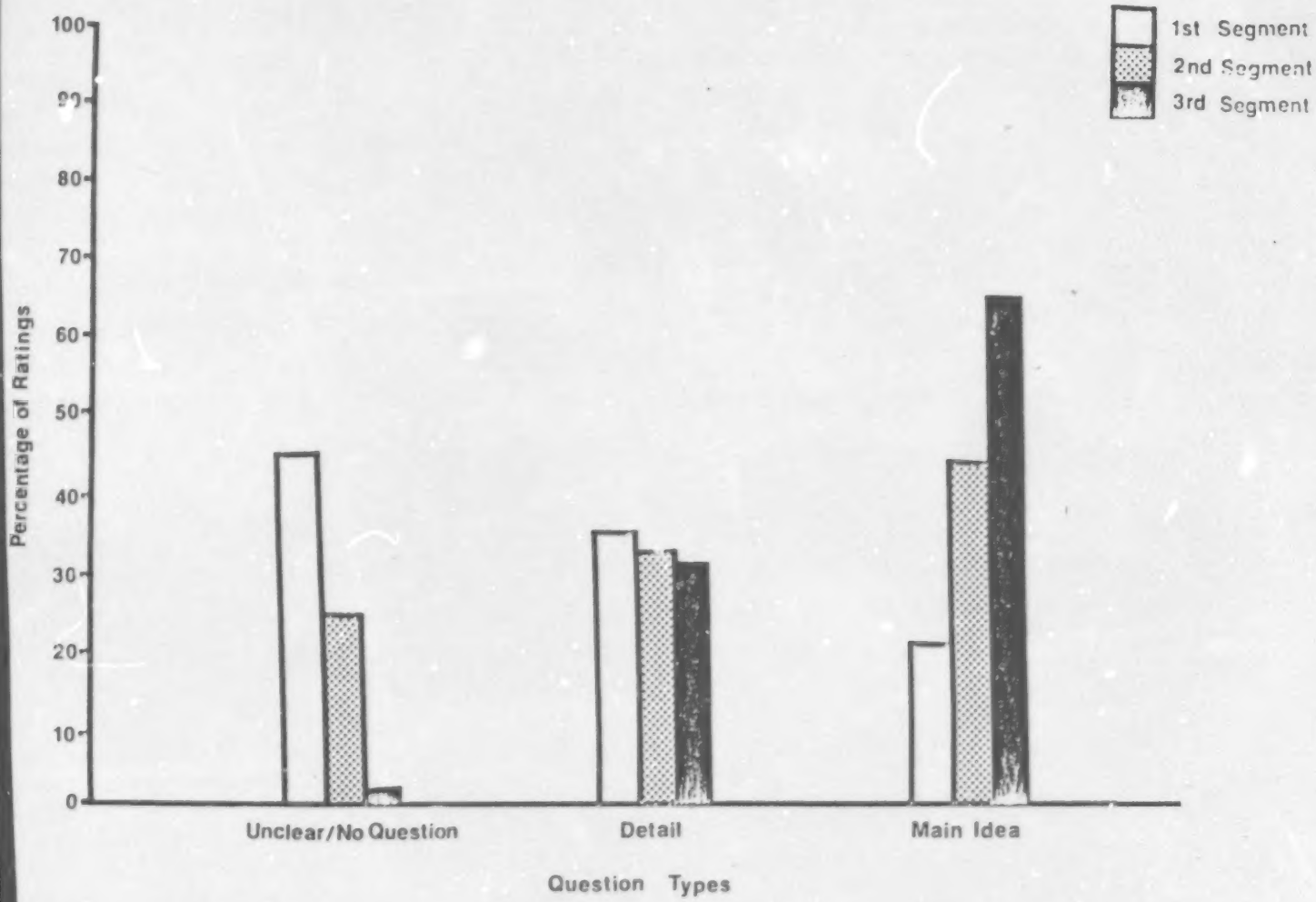
Figure 8. Reciprocal teaching of the four strategies of summarization, questioning, clarifying, and predicting, compared with reciprocal teaching of only questioning or summarizing.

Figure 9. Daily independent assessments on the students taught by four volunteers in a natural classroom setting. (from Palincsar & Brown, 1984, Study 2)

Figure 10. Independent assessment scores of the students taught by the six nonvolunteer teachers in large group setting.

Figure 11. Independent assessment scores for both the tutors and tutees in the peer tutoring study.

Figure 12. Independent assessment scores from first graders in the pilot listening comprehension study. (RT = reciprocal teaching, EI = explicit instruction of the four strategies, and T = a test only control)



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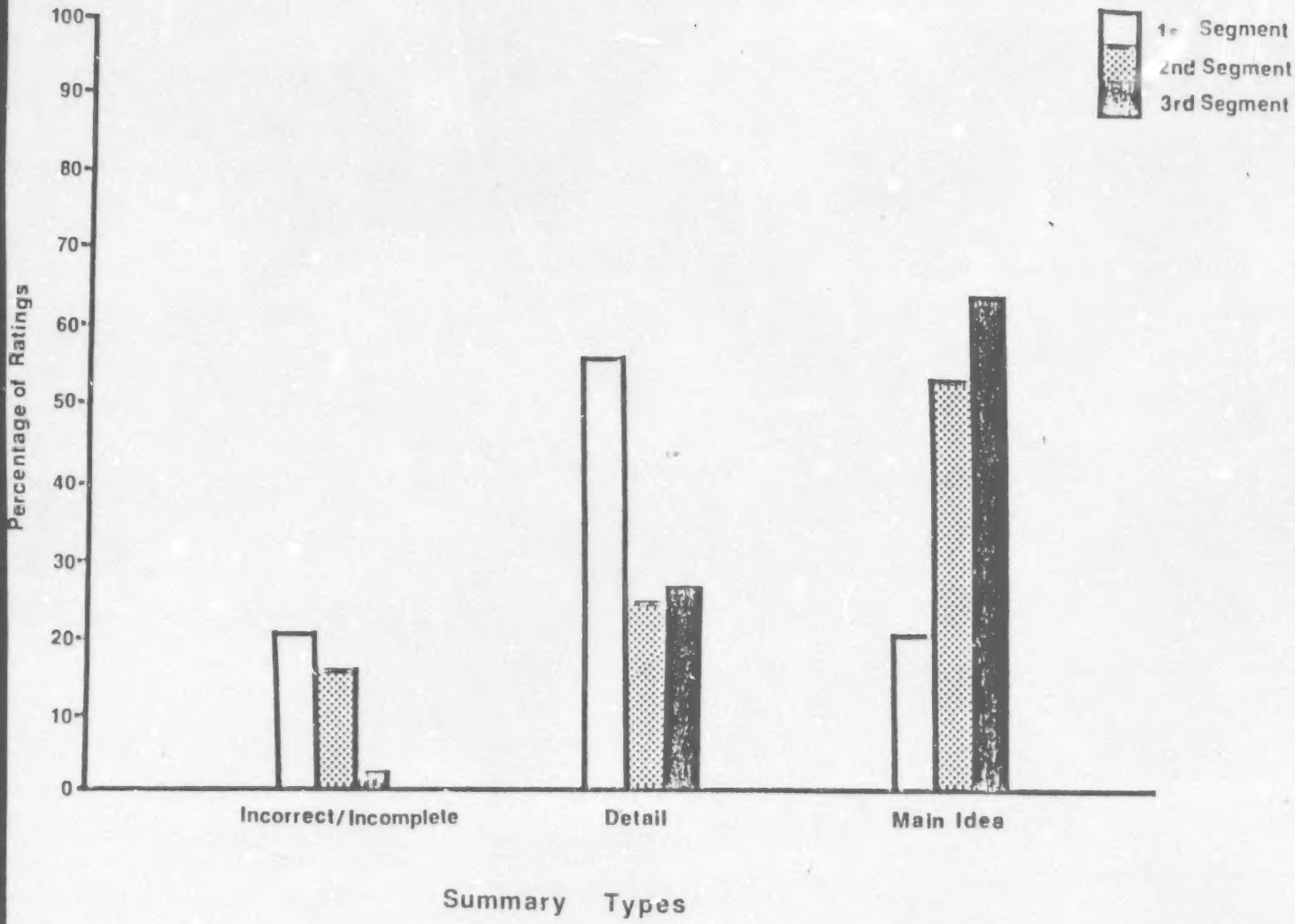
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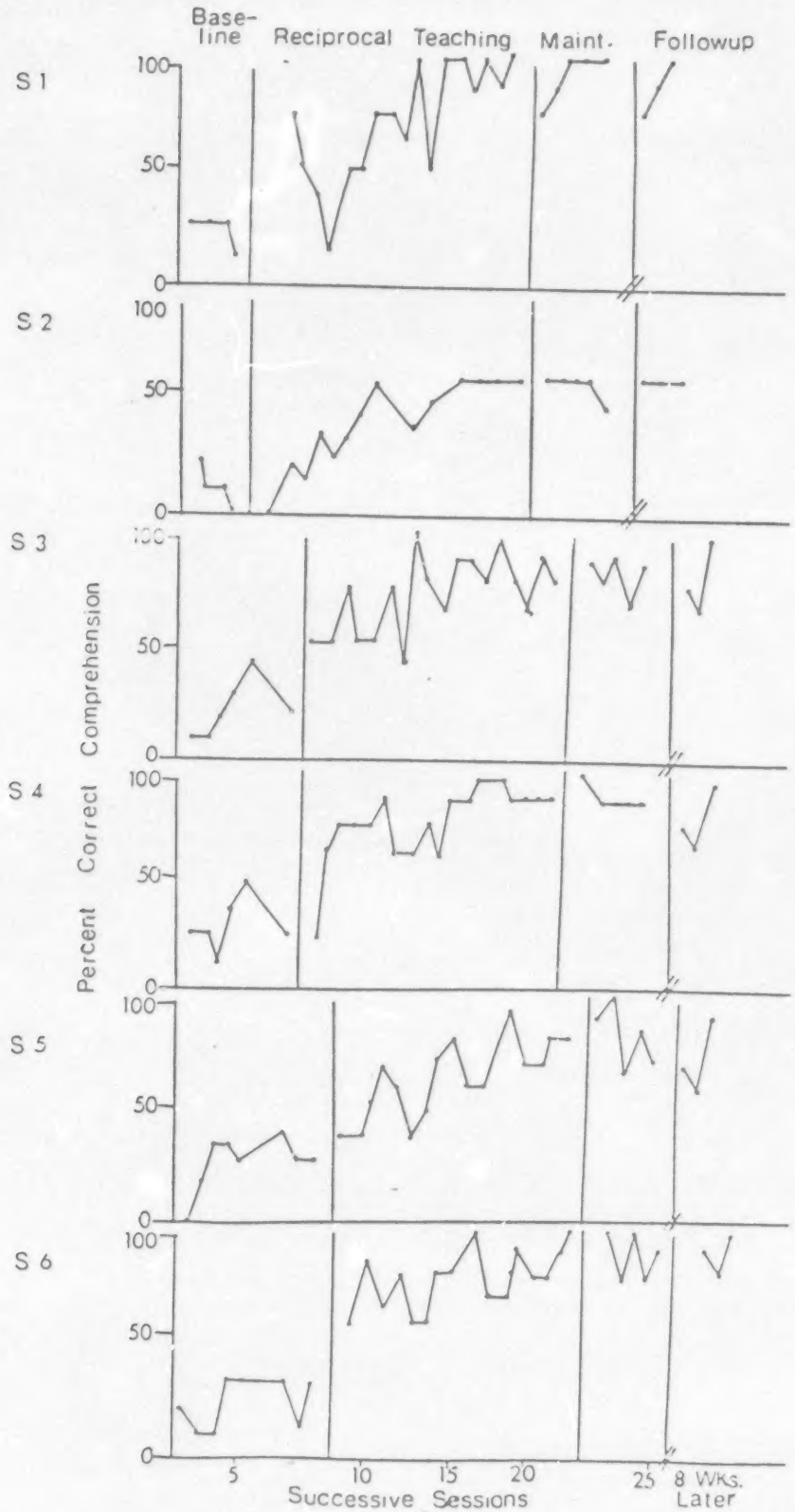
Detail
Main Idea
Summary Types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Reciprocal Teaching
Maint.
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Percent Correct Comprehension
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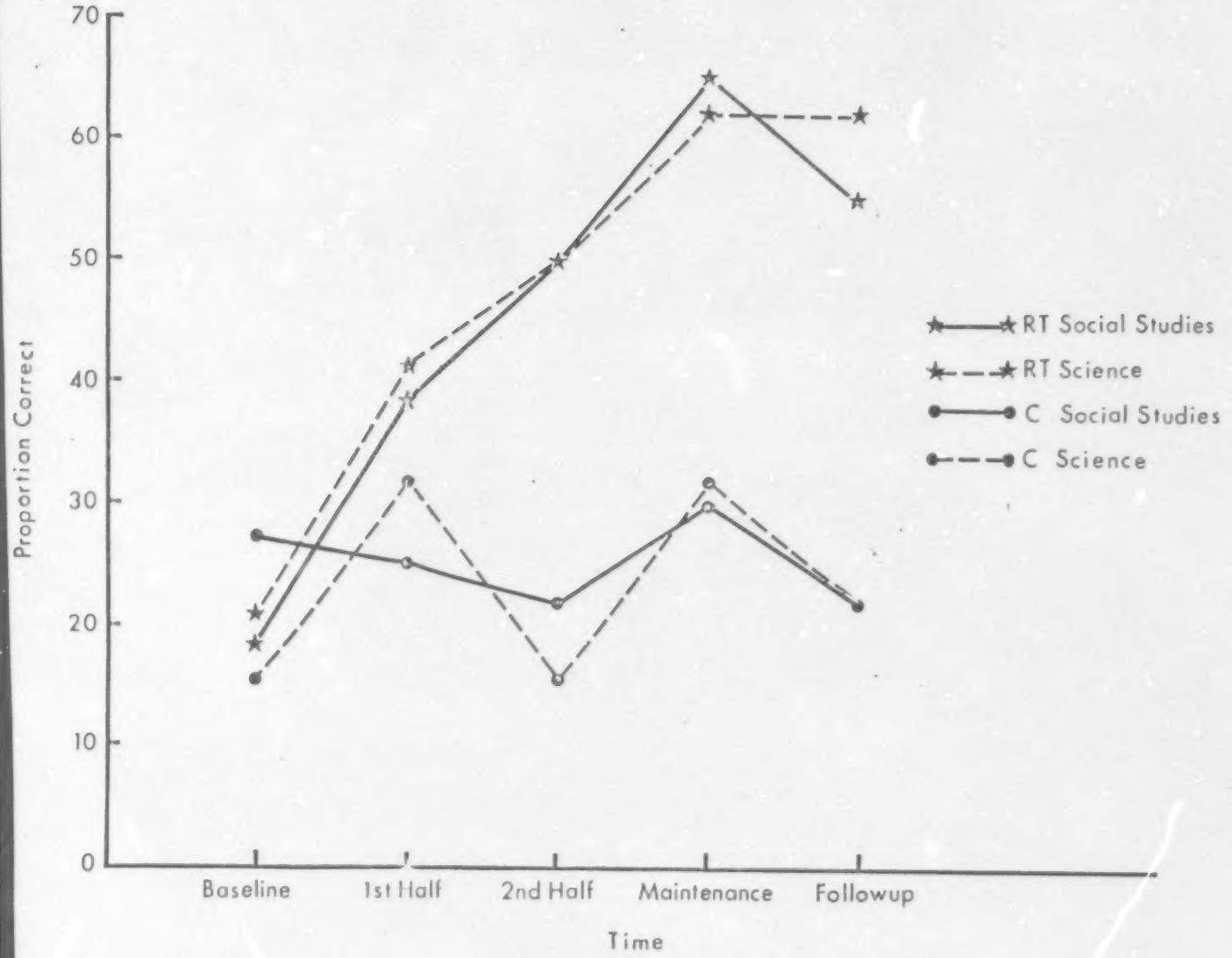
Later
Successive Sessions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C Social Studies
C Science
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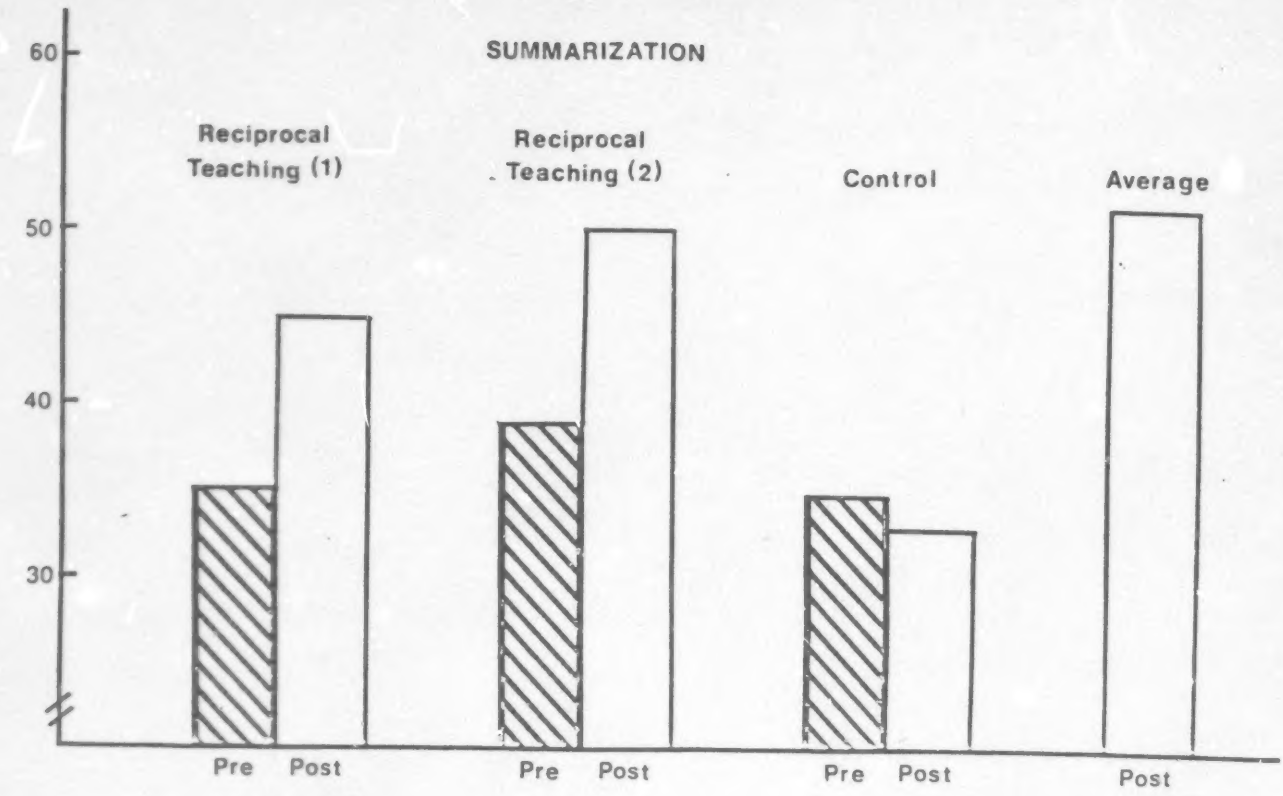
Maintenance
Followup
Time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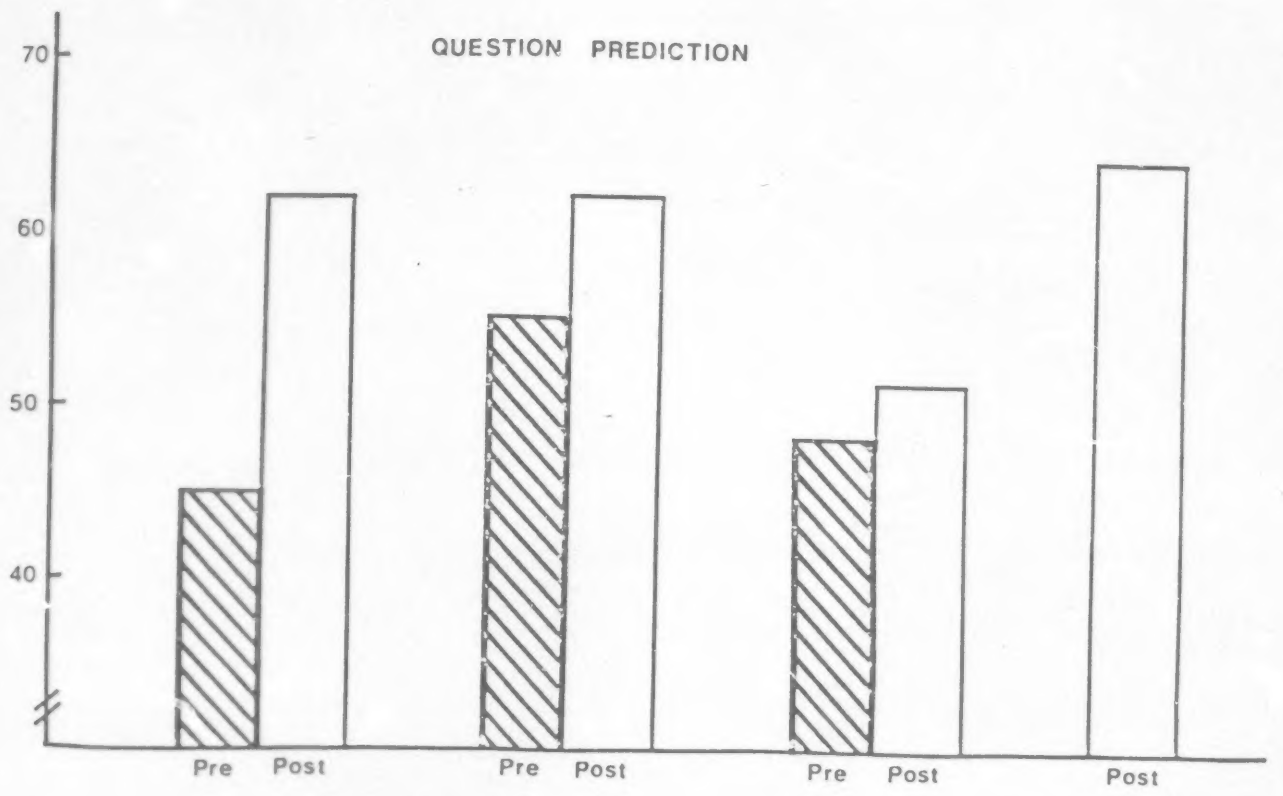
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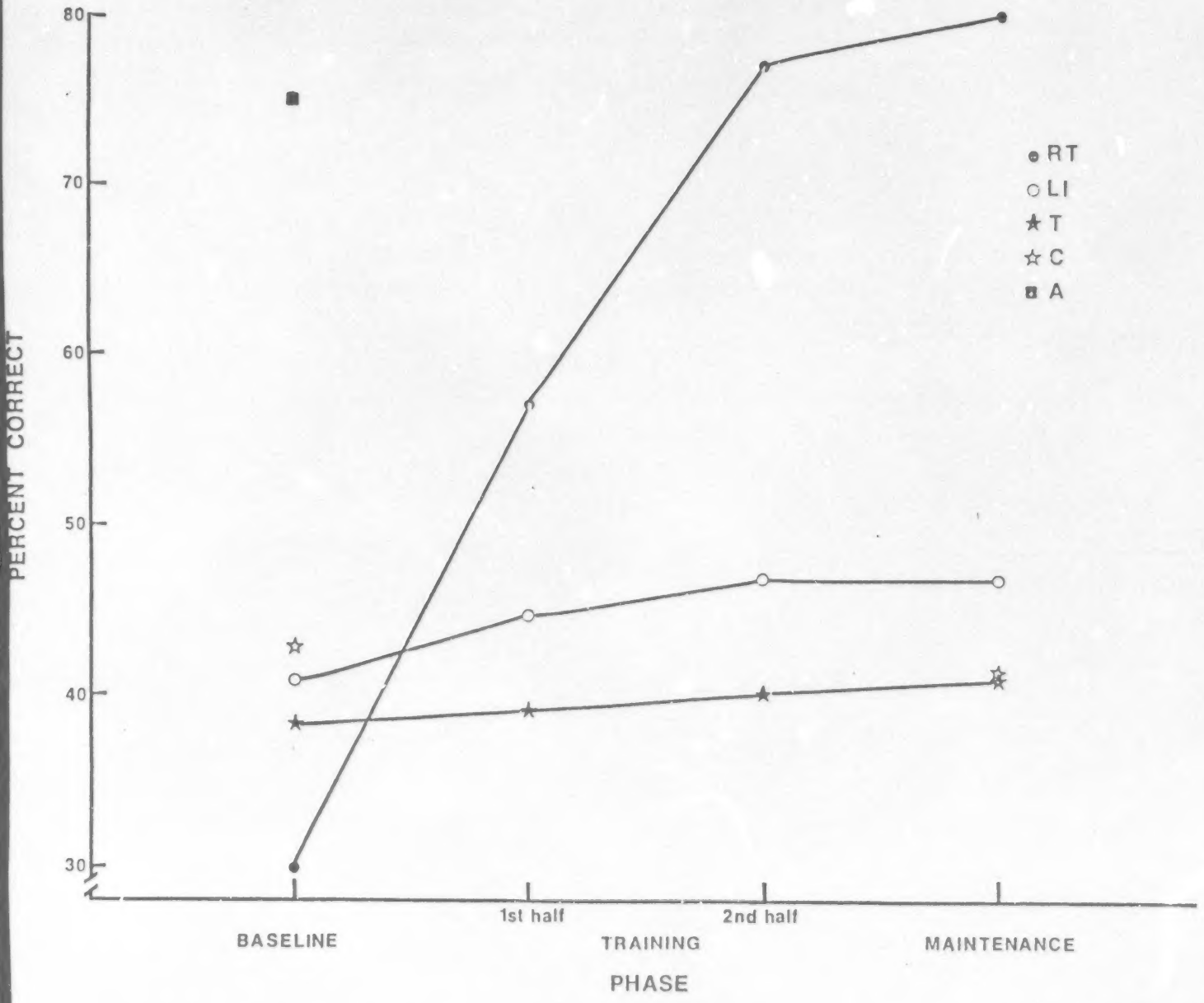
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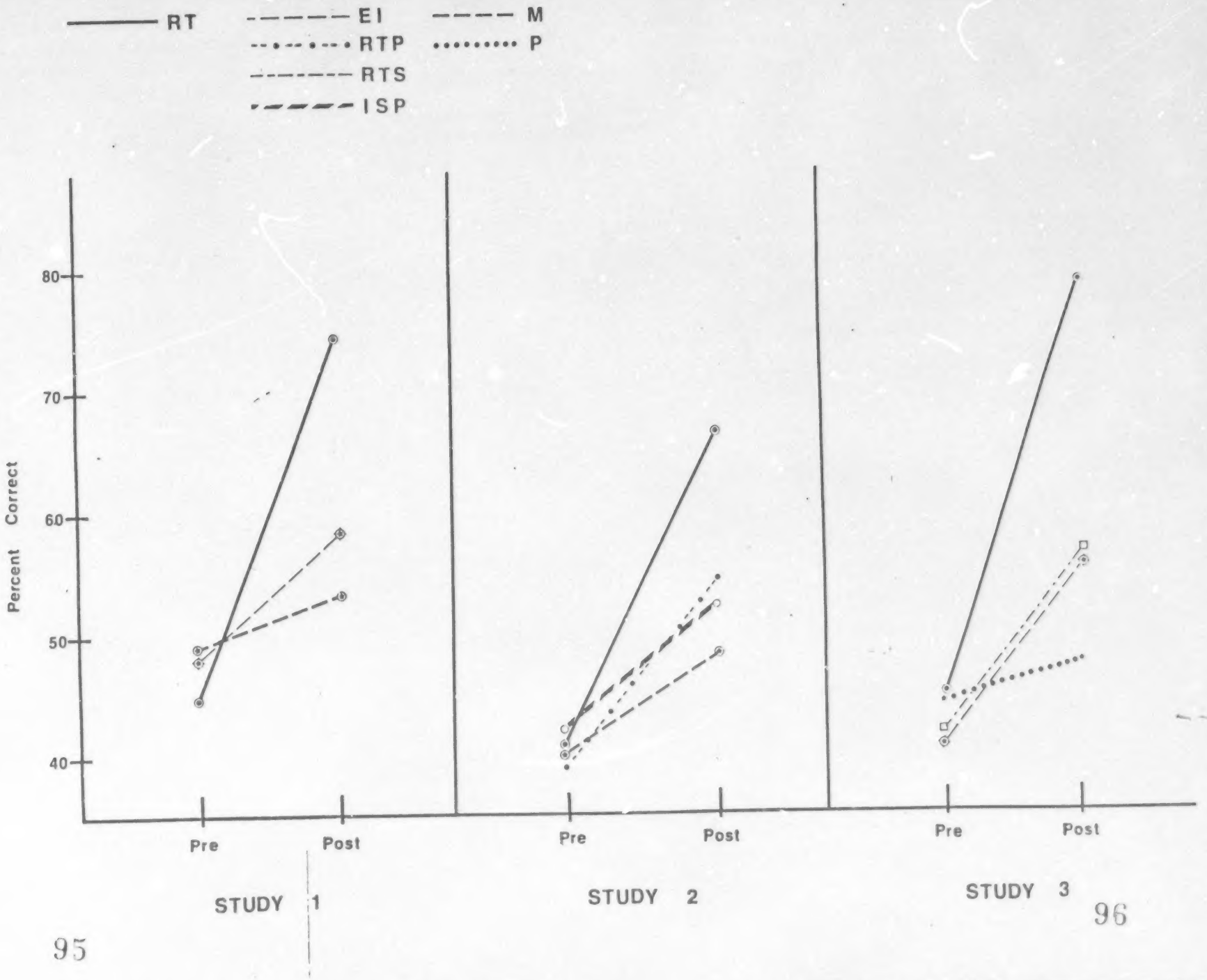
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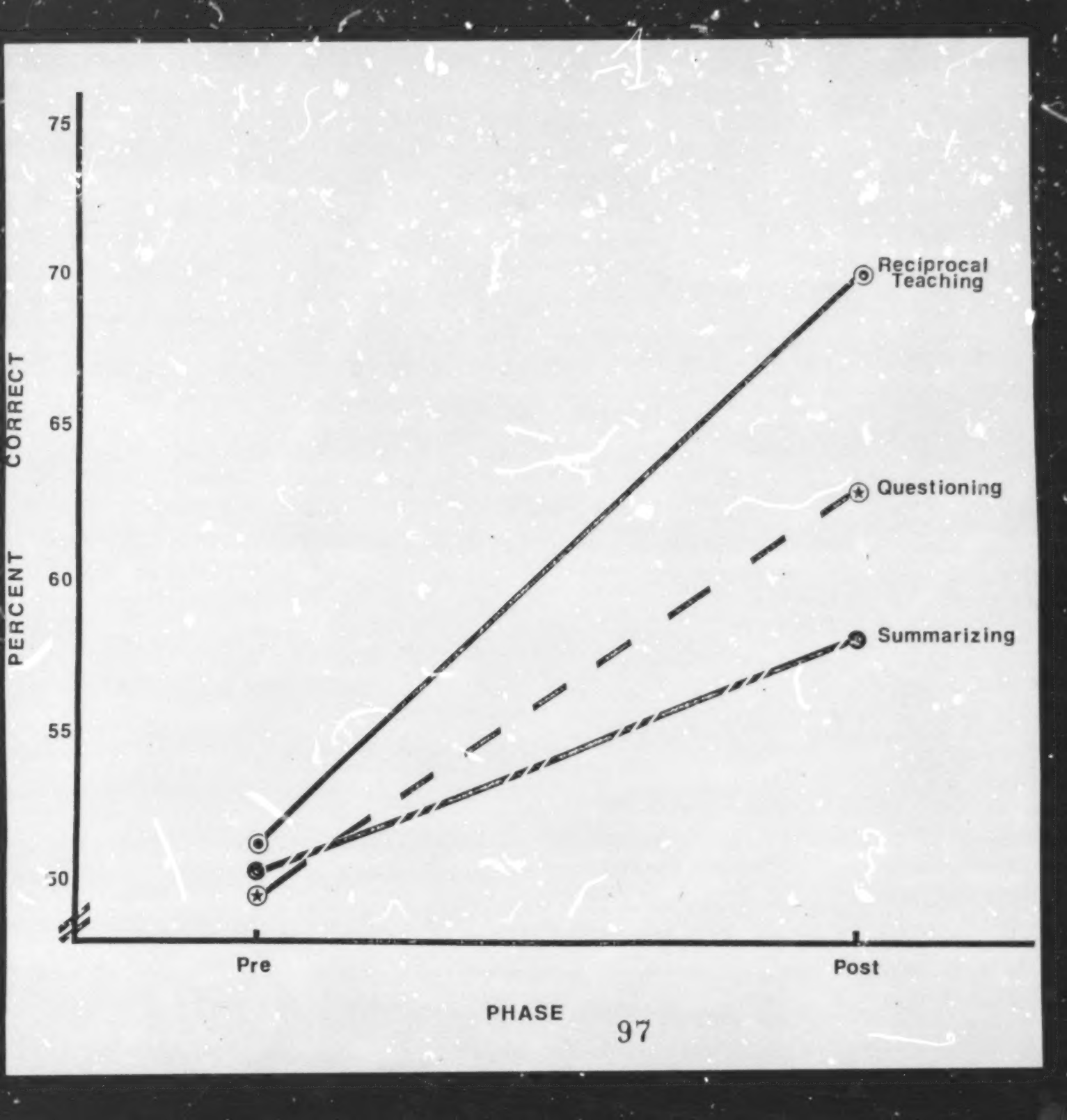
STUDY 3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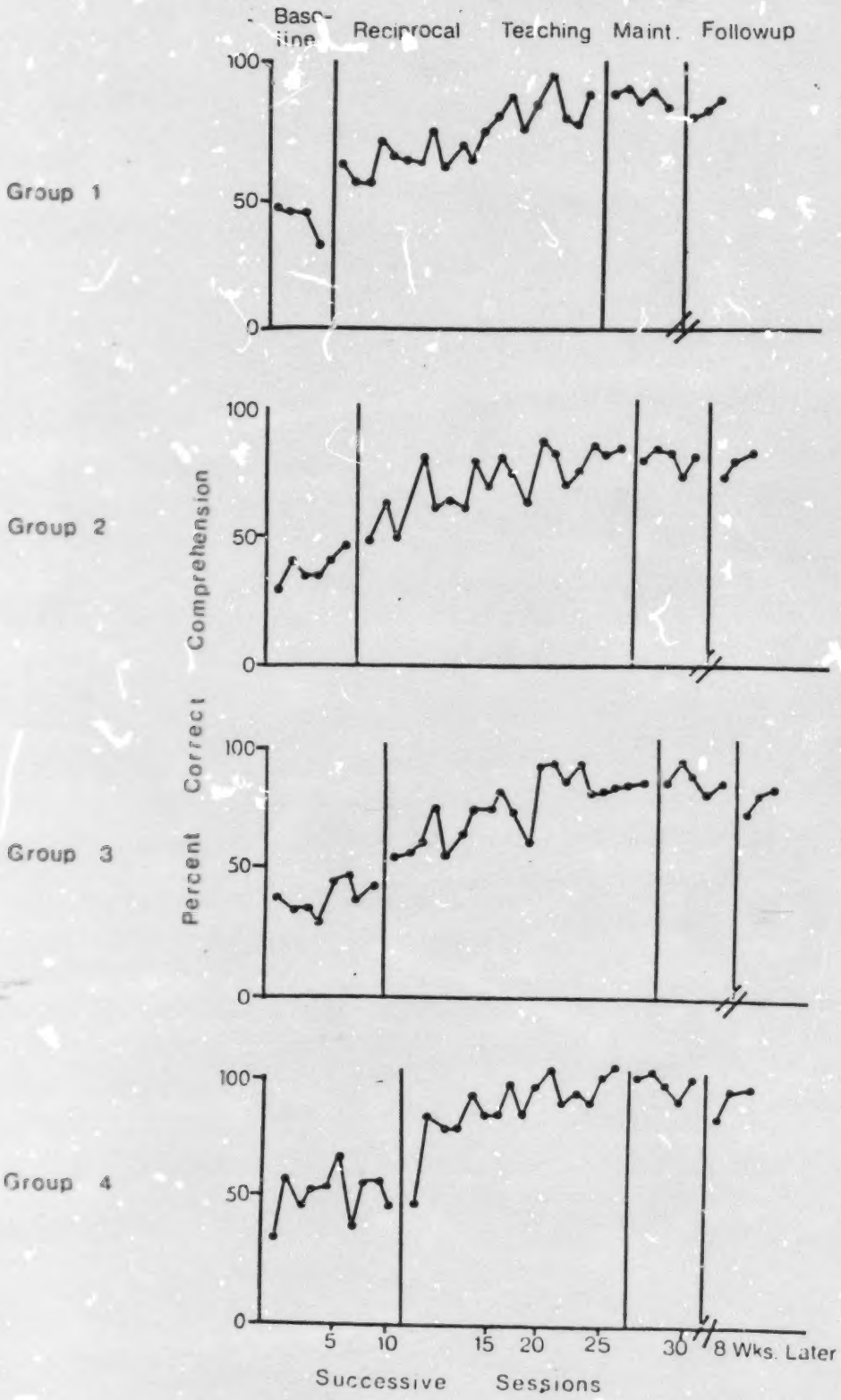
Base-line
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Followup
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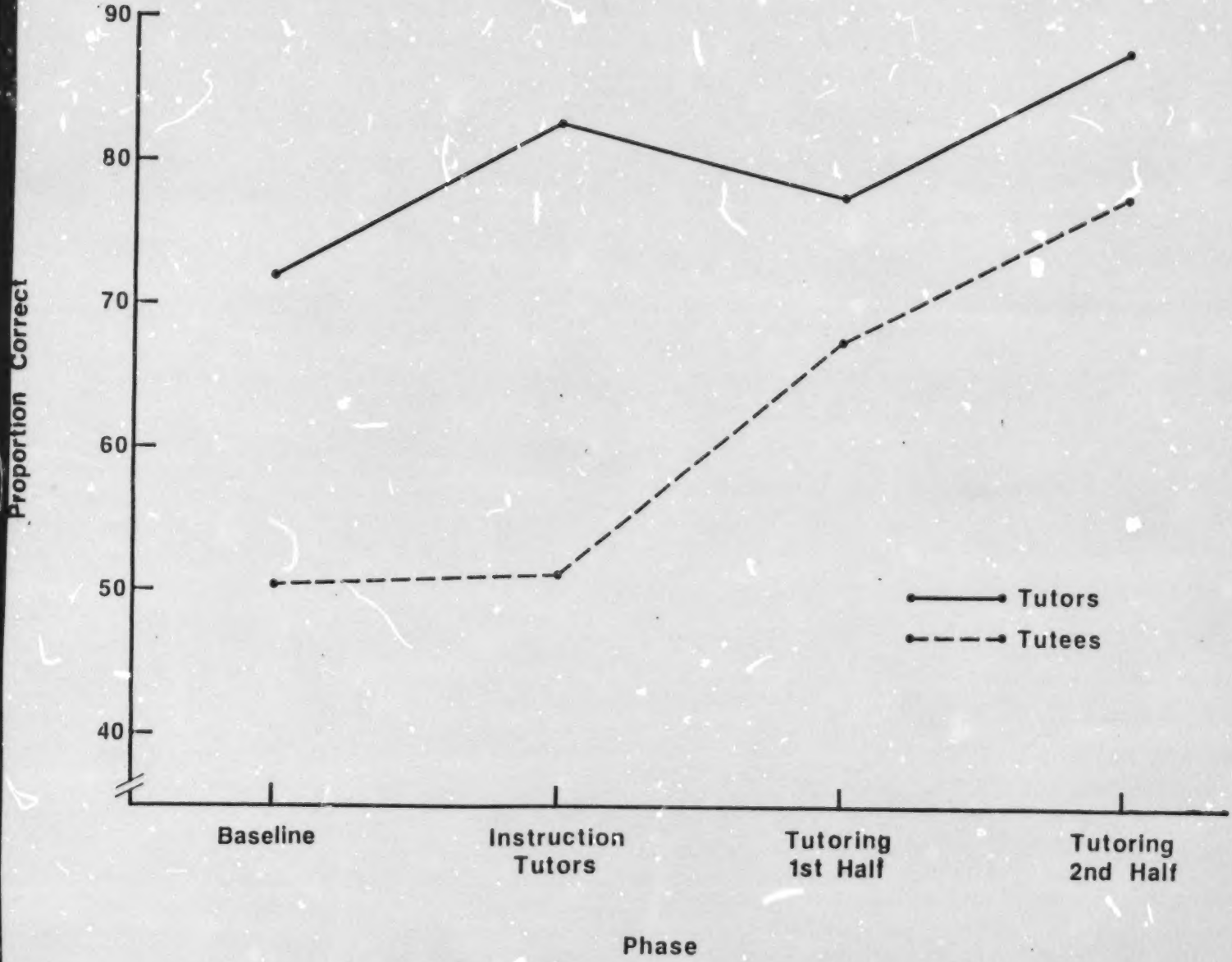
Successive Sessions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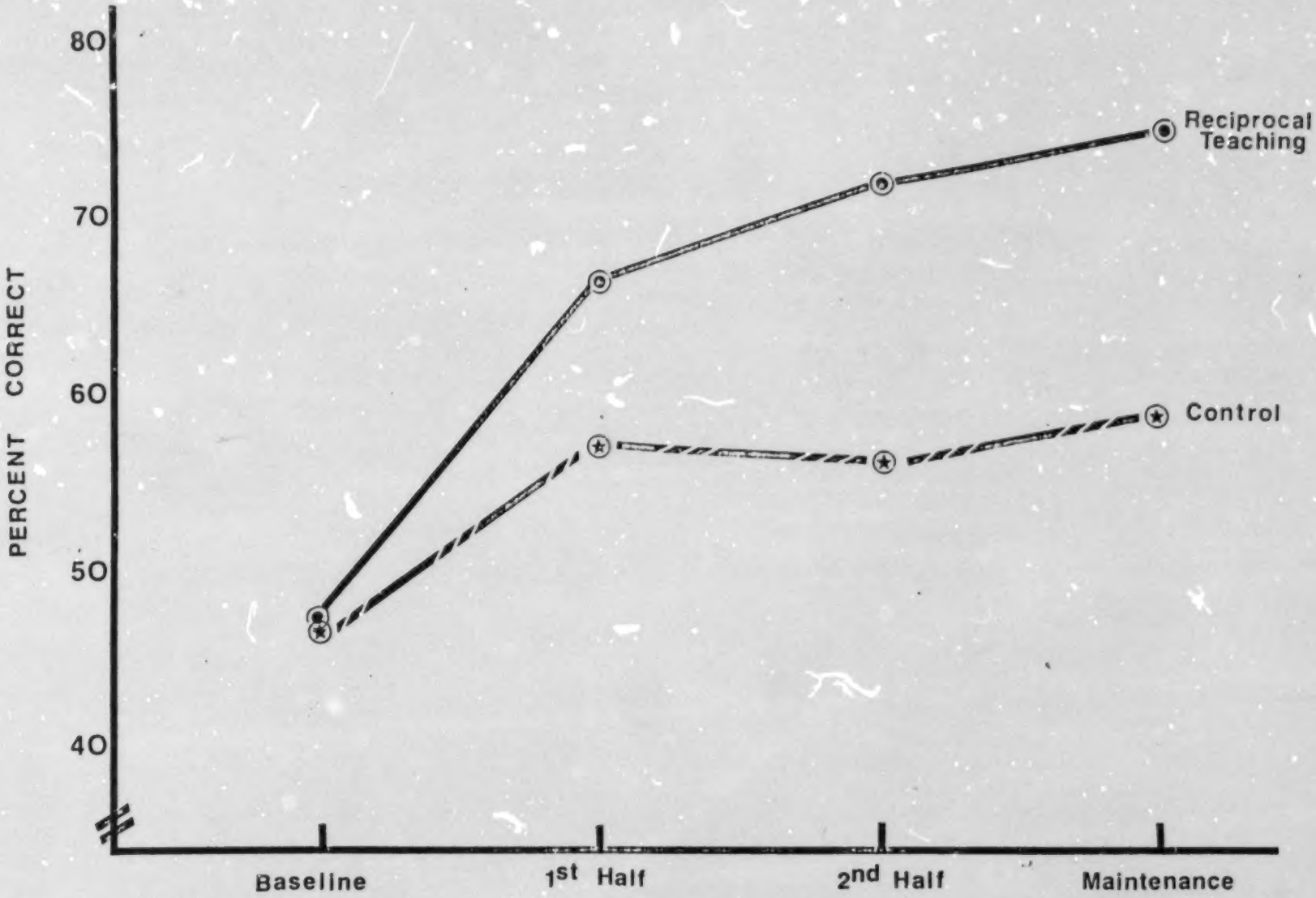
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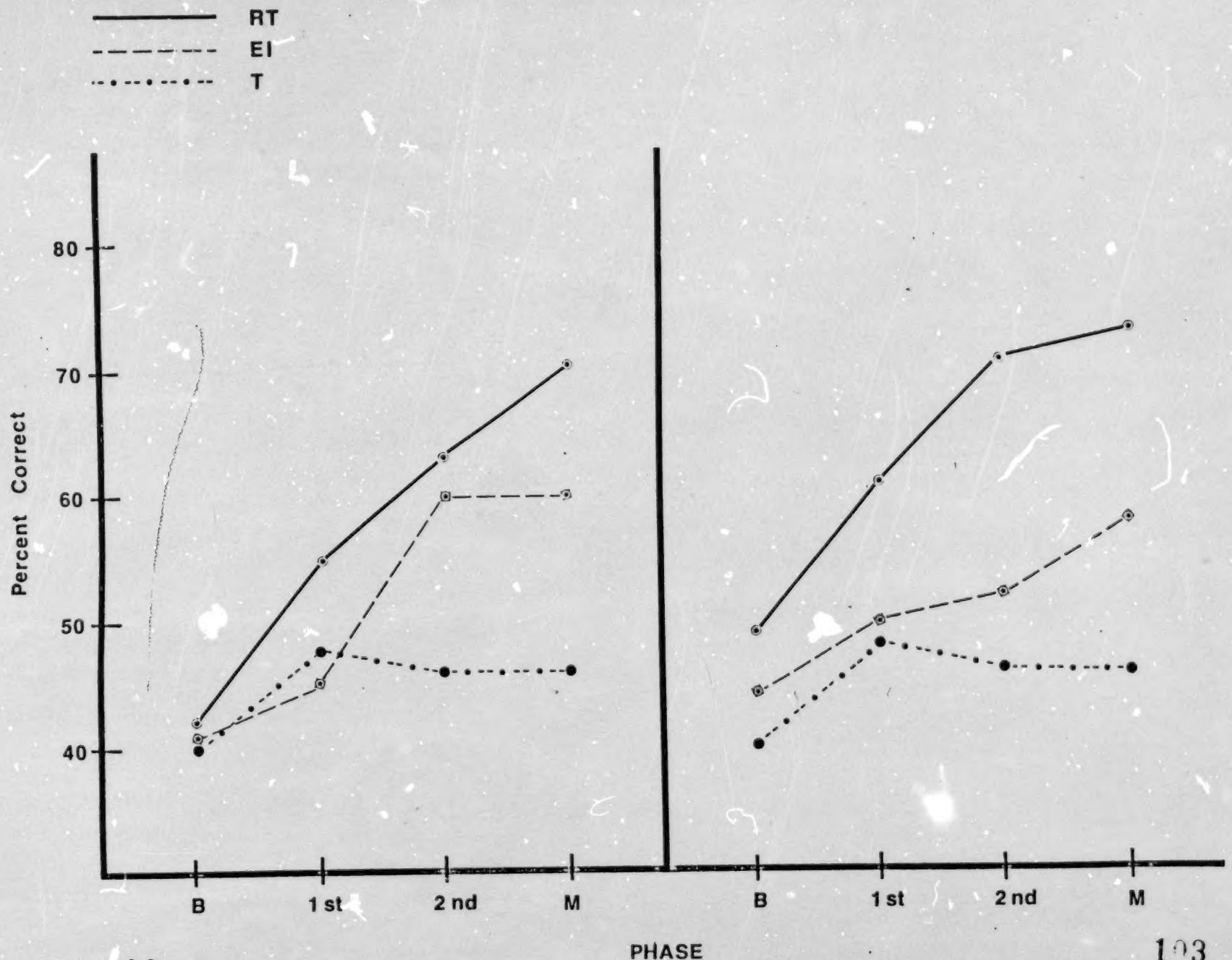
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